FLYING

including **INDUSTRIAL AVIATION**

SEPTEMBER, 1943

VOLUME 33 • NUMBER 3

ENGINEERING

Steady Aim! 30

TRAINING

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Hangar Heroes ..... Kurt Rand 43

MILITARY

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Cover Photograph: Woman Worker on Douglas DC-3 by Lawrence Kronquist

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Circulation Director

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WHAT ABOUT THE FUTURE?

With a global war well into its second year and many vital problems yet to be solved, it is only natural that American youth today should be concerned with the necessarily big question—What of my future and how can I best serve my country?

With air power playing an increasingly important role in this epic drama, hundreds of thousands of technically trained men are needed in production, transport, training and in the armed forces. What better answer, then, could there possibly be than adequate technical training for a successful career in the future's most promising industry—American Aviation?

Curtiss-Wright Technical Institute's specialized Aeronautical Engineering and Master Aviation Mechanics courses are specifically designed thoroughly to equip you not only for a broad career but likewise for infinitely greater service to your country. Upon completion of one or more of these courses you will be in a position to command and enjoy a prosperous future, with virtually unlimited opportunities and assurance of rapid advancement in your chosen field. In case of military service you will be in line for higher technical grades and ratings. But do not make the mistake of delaying, especially if you are in the neighborhood of 17 years of age. Now is the accepted time. It's the opportunity which knocks but once at every man's door.

Thousands of Curtiss-Wright Tech's graduates now are engaged in various phases of aviation activities. All are making notable contributions to the national war effort. They will not permit final victory to find them unprepared. Get this essential training now, while it still is available to you, a civilian.

Since 1929, CURTISS-WRIGHT TECHNICAL INSTITUTE has been engaged in training young men for lifetime careers in aviation. In addition, we are training literally hundreds of Army Air Force mechanics, under contract to the Government, a job we took on long before the war. We know how! Your opportunity is here and now. Send in your enrollment at once. THERE'S NO TIME LIKE THE PRESENT.

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Curtiss-Wright Technical Institute has an unsurpassed faculty of practical and experienced engineers and technicians.

Curtiss-Wright Technical Institute's high standing in the industry is indicated by the fact that Mr. Donald L. Douglas, President of the great Douglas Aircraft Company, chose this school for his own son's training.

Curtiss-Wright Technical Institute is located in Grand Central Air Terminal, Glendale, the very center of Southern California's giant aircraft industry.

Curtiss-Wright Technical Institute's thousands of successful graduates prove that its thorough training gets results. The demand for our graduates far exceeds the supply.

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Trail Blazing in the Skies

1934

THE ART OF FABRICATING AIRCRAFT STRUCTURES was greatly advanced by a series of unique strength-model tests developed by Goodyear Aircraft Corporation in 1934. A method was devised by which the performance of full-scale air frames can be accurately determined by model tests. These tests provide exact duplication of axial, bending, torsional and shear characteristics of prototype members — under various load combinations. As a result, stresses, strains and effect of loads on all types of aircraft components can now be determined by aircraft designers more precisely than ever before.

HOW GOODYEAR AIRCRAFT CORPORATION SERVES THE AIRCRAFT INDUSTRY

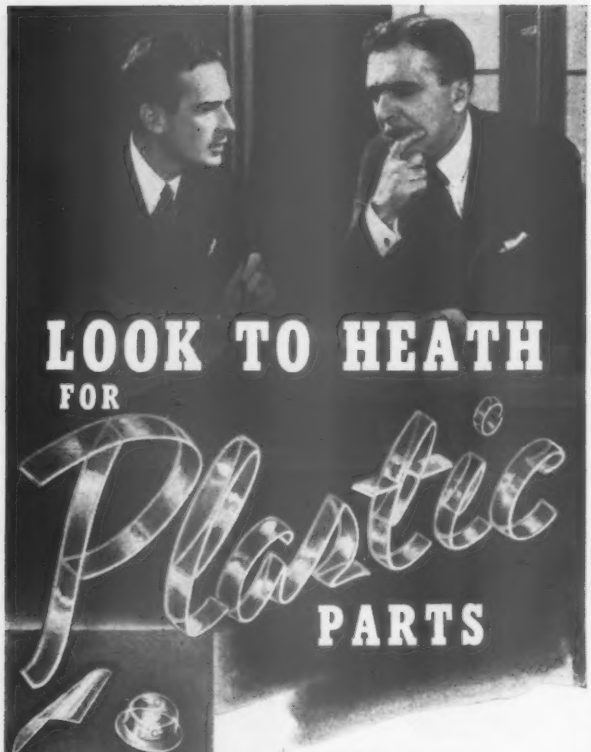
1. *By constructing subassemblies to manufacturers' specifications.*
2. *By designing parts for all types of airplanes.*
3. *By re-engineering parts for mass production.*
4. *By extending our research facilities to aid the solution of any design or engineering problem.*
5. *By building complete airplanes and airships.*

1943

"APPLICATION OF THESE PRINCIPLES in the construction of airplane components has enabled Goodyear Aircraft to design and fabricate intricate aircraft structures meeting the highest standards for strength and quality. That Goodyear parts meet the most rigorous specifications of the industry and the air services is emphasized by the great variety of tail, wing and fuselage assemblies we are producing for a number of manufacturers of America's most famous warplanes, both bombers and fighters—and is further exemplified in our own output of complete airships and the Corsair FG-1.

GOODYEAR

GOODYEAR AIRCRAFT



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AT DEADLINE

by MAX KARANT

A USAAF Bomber Station Somewhere in England: There is a bloody war going on in the air over Europe. It's no Hollywood war; it's tough, and American airmen are being lost regularly. Though our losses are small in proportion to the numbers flying against the enemy, a certain number of healthy young men from Texas, Iowa or Brooklyn are losing their lives fighting the Hun over here, several thousand miles from home.

As this is written, I have been in the British Isles only about two weeks. But in that time I have visited fighter and bomber stations in many parts of Britain and have stayed up late evenings talking with those kids from the States. Their first question, without exception, is the same: have the people back home snapped out of it yet? By all odds the one thing our airmen are angriest about is the strikes of labor at home—and the manner in which Washington has handled the situation. All the pilots, navigators, radiomen, bombardiers, gunners and ground crewmen at one bomber station here had to be restrained from sending John L. Lewis a blunt invitation to come to England at their expense, and accompany them on just one mission over Germany. Strangely, that seems to be the attitude of RAF airmen with whom I've talked, though they are a good deal more restrained about it. They can't quite comprehend why it's permitted to exist; unlike the American boys, they seem to think there must be some sort of political strategy behind it all that justifies it, even though there's a war on.

It was something of a surprise to find such a national question uppermost in the minds of boys who ordinarily care little for anything other than flying. The fact remains, however, that the subject of John L. Lewis and his strikes are talked about just as much as the newest tactics of the Focke-Wulf pilots.

* * * * *

Because of the great amount of talk around the States about the Republic *Thunderbolt* (P-47), one of my first visits here was to a *Thunderbolt* station. Nearly all the pilots had previous experience on other U.S. fighters, so their opinions of the *Thunderbolt* are based on fact. In addition, they have flown a considerable number of missions against the enemy, have fought the best the Germans have, and have shot down a substantial number of them. These are the conclusions I have found:

LIABILITIES:—The *Thunderbolt's* rate of climb at low and medium altitudes is not what its pilots would like it to be. At its best altitude, however, this airplane can match any other plane in the world.

It does not have enough range. Both the pilots of the *Thunderbolts* and those of the bombers they are designed to escort complain about this. While bomber losses are well below the maximum our Air Forces could afford to lose, and the *Flying Fortress* has a phenomenal record for being able to take care of itself, bomber pilots feel their losses could be even further reduced by the presence of heavily armed fighters like the *Thunderbolt*.

ASSETS:—As a sheer fighting aircraft its pilots say it is the most formidable of its type—and that takes into account all Allied and enemy fighters. Much of this statement is based on the *Thunderbolt's* eight .50 caliber machine guns. I lived at this station for two days and, without exception, every pilot to whom I put the question gave the same answer.

The airplane is one of the most rugged ever produced in the United States. In making forced landings *Thunderbolts* have chopped down small trees with their wings without injuring the pilots. Several pilots felt that the airplane could spare some of its structural strength so as to reduce its overall weight and thereby increase its rate of climb at low and medium altitudes.

The *Thunderbolt* can out-dive any aircraft known today. This is due partially to its great structural strength and par-

(*Continued on page* 141)

Buy War Bonds and Stamps

Maybe he's your boy

He had waited anxiously for this moment. Then, early one morning, his instructor hopped out of the Boeing PT-17 Kaydet and casually waved this youngster off on his first solo.

He felt a chill, a sinking wave of uncertainty, and then excitement . . . the exultant climactic realization that "This is it!" He shoved the throttle ahead and for the first time in his life lifted up into the sky . . . on his own!

When he climbed out of the sturdy trainer, he glowed with expansive pride. He was a *flier* now, and gloriously happy.

If you had been there, you'd have seen him give his Boeing Kaydet a friendly pat. For, like all fliers, he feels a real affection for the primary trainer that first lent him wings.

If your son, or brother, or that boy from down the street, is now in the Army or Navy flying services, chances are that he, too, received his first flight instruction in a Boeing designed and built airplane. For more Army and Navy pilots have gotten their initial training in Boeing primary trainers than in any other primary training planes. Boeing has delivered, all told, more than 7000 expertly engineered, soundly constructed Boeing Kaydets to the United Nations.

Boeing Kaydets are built at Boeing's plant in Wichita, Kansas. Not as spectacular as their big brothers, the Flying Fortresses,* they are, nonetheless, built to the same unyielding standards of design, engineering and manufacture.

Boeing products have always exceeded the claims advanced for them. True today, it will be equally true of any product tomorrow . . . if it's "Built by Boeing" it's bound to be good.

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*THE TERMS "FLYING FORTRESS" AND "STRATOLINER" ARE REGISTERED BOEING TRADE-MARKS

The Birdmen's Perch

A while back we got a Braintwister from Bob Harvey, of Fresno.

He even sent the answer!—so we put it in the Perch. (It was about a 100-mile round trip from A to B, with a headwind one way, a tailwind on the return.)

Well, it was probably the best Braintwister we've ever had, according to you Perch Pilots. There can't be more than 10 or 12 flyers left in the country who've not written to us . . . we got one letter from the *entire class* of an AAF school! We're *still* getting requests for the answer.

Congratulations, Bob Harvey, and may all your planes fly like fighters and handle like PT's. We hereby appoint you honorary Brainbuster for 1943.

Got any more?

Major Al Williams,
alias, "Tattered Wing Tips," Gulf Aviation Products Manager, Gulf Bldg., Pittsburgh, Pa.

CLEANING AND COMPRESSING

The Army Ordnance Field Service Division has a new wrinkle.

They call it the "dehydration of war weapons." Honest! But they don't squeeze water out of war weapons—they squeeze "dead" space. They cut corners on crates and boxes; they fit the containers to the weapons instead of the other way around; they ship vehicles disassembled with all the accessories jammed into the same box . . . they eliminate every possible cubic

inch of waste space. And this rearrangement results in increased efficiency in our lines of supply.

The Alchlor Process is a development in refining which eliminates the "waste" hydrocarbons from Gulfpride Oil. This super-refining technique is the most effective method for "eliminating" the impurities and unstable hydrocarbons (which cause oxidation and gum and sludge formation) from the oil. It even rearranges the molecular structure of certain of the hydrocarbons. And this rearrangement results in increased lubrication efficiency from Gulfpride.

BRAINTWISTER

(Twisted by J. B. Cunningham, Reno, Nev.)

Half the planes of a formation, plus one half a plane more than half, were forced down on the first leg of a flight. Half of the planes left, plus one half a plane more than half, were downed on the second leg. Half of the planes left, plus one half a plane more than half, were downed on the third leg. Half the planes left, plus one half a plane more than half, were downed on the last leg. One plane arrived at the final port.

How many started? Write for the answer.

G.L.S.E.—THE MAN WHO OILS THE WAR EFFORT

We've told you from time to time about how various war plants have stepped up production on war needs by making use of the proper Gulf lubricants, cutting oils, quenching oils, etc.

In many of these plants, the increases in quantity and quality were due to the counsel of the Gulf Lubrication Service Engineers.

These men combine petroleum knowledge with broad experience in industrial production and maintenance and are prepared to help you find the answer to *any* lubrication problem. They are available to every plant, mine and industrial operation in 30 states, from Maine to New Mexico.

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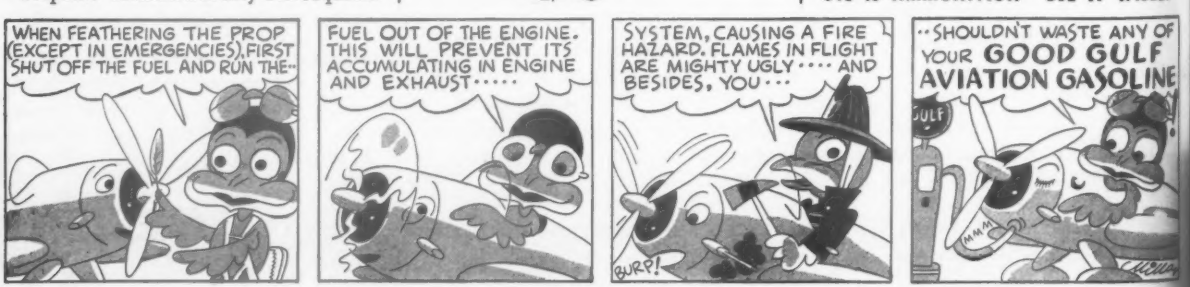
WHEN FEATHERING THE PROP (EXCEPT IN EMERGENCIES), FIRST SHUT OFF THE FUEL AND RUN THE··
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SYSTEM, CAUSING A FIRE HAZARD. FLAMES IN FLIGHT ARE MIGHTY UGLY···· AND BESIDES, YOU···
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Our gallant airmen are triumphantly carrying America's colors across the skies of the world . . . flying for freedom's cause, to insure a better peaceful world of tomorrow.

The outstanding performance of America's planes and the men who fly them in today's war is a portent of the future . . . when this same leadership will produce the greatest aviation progress the world has ever seen.

Today, as a contractor to the U. S. Army and Navy, Spartan devotes long experience and proved skill only for Victory. Our present war work will leave us even better equipped for peace-time production of modern Spartan commercial aircraft.

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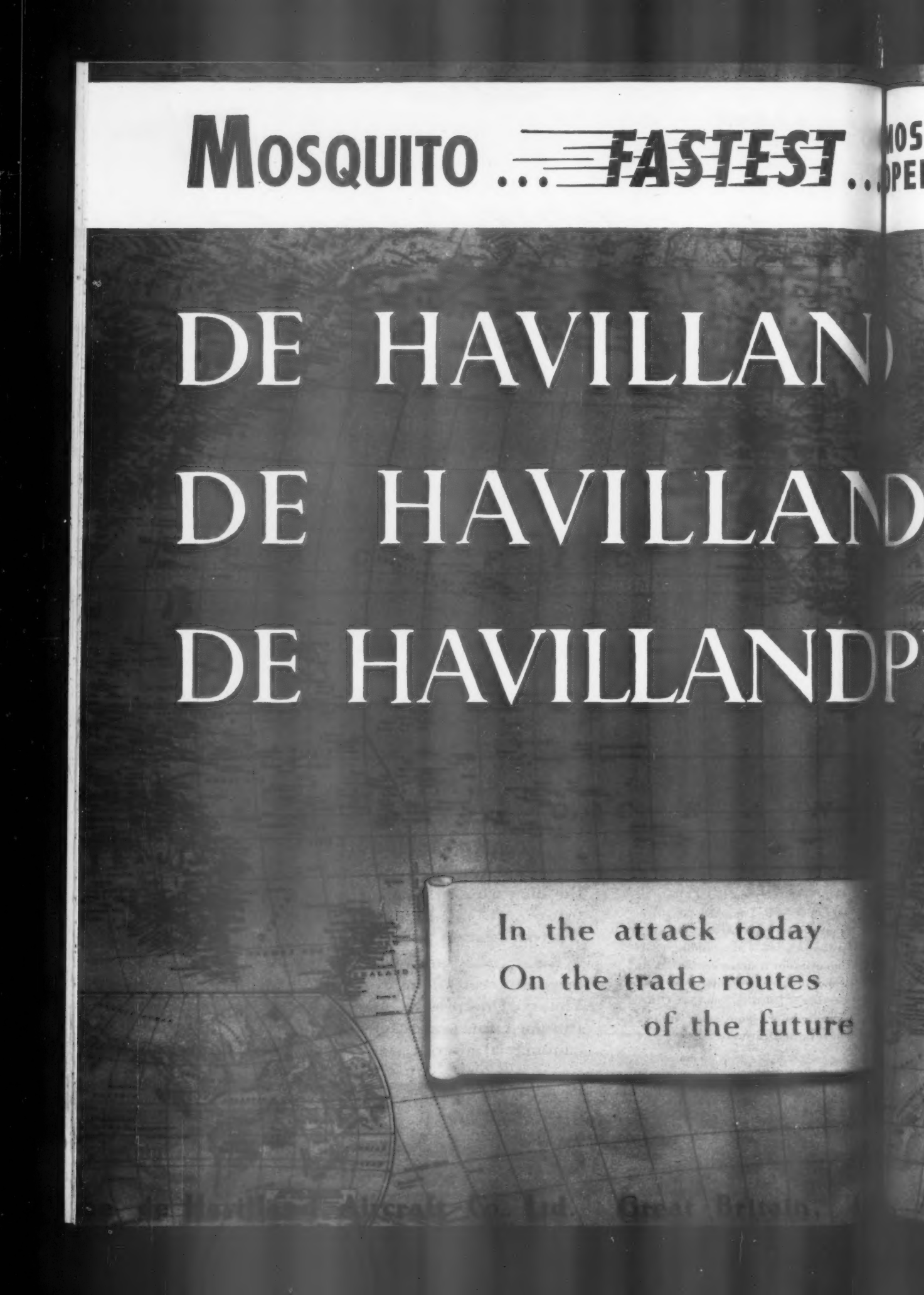
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In the attack today
On the trade routes
of the future

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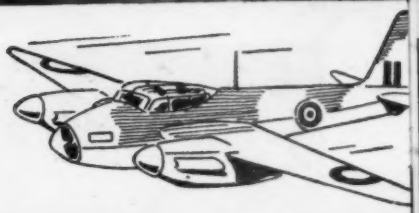

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ARMY E NAVY

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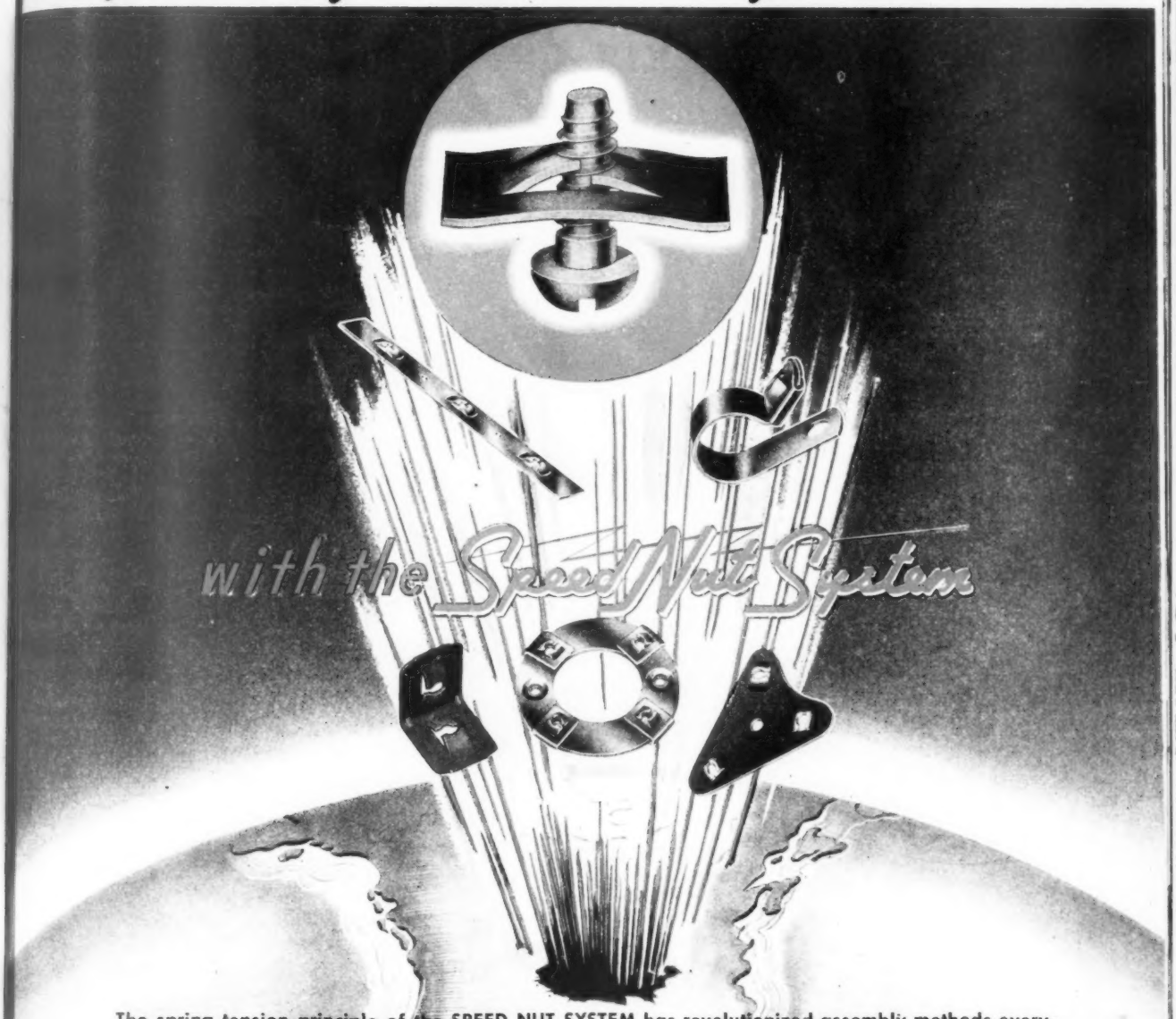
Exploding old assembly methods..



The spring tension principle of the SPEED NUT SYSTEM has revolutionized assembly methods everywhere. Now, in many cases, one SPEED NUT performs multiple functions, reduces number of parts, eliminates handling operations and drastically cuts weight and production costs.

For example: Our complete line of SPEED NUT angles combines the angle bracket and fastener into a single part. Self-retaining SPEED NUTS for all types of conduit clamps speed up assembly by eliminating unnecessary handling of parts. SPEED NUT retainer rings cut riveting operations to a minimum and save both in material and weight. SPEED NUT strips replace extruded gang channels. And our triangular nut plate for attachment of running lights, cuts riveting operations from 6 to 1. These are only 5 out of dozens of SPEED NUT designs that have virtually exploded conventional assembly methods. Write for our new summary catalog No. 185.

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Another Martin First!

NEW MARTIN RIVET FEEDER CUTS RIVETING TIME 30%!

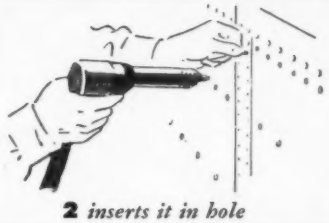
REDUCING riveting time on aircraft by 30%, this rivet feeder—a new Martin development—changes rivet guns from "single shots" to "automatics." Now undergoing work-tests, the feeder will soon be made available to all industry.

In the form of a magazine, attached to standard rivet guns, the feeder is operated by exhaust air which slides rivets forward, ready for the hole. With one movement of the gun, the worker puts the rivet in place; with another he drives it home. Picking up a rivet and inserting it by hand are eliminated; the worker's hands stay on the rivet gun until a clip is exhausted. Reloading consists merely of dumping rivets through a small door in the feeder.

In the driving of ice-box rivets, faster riveting means less time for rivets to warm up. Since they are untouched by the hand, they are cooler when driven home. The feeder costs nothing to operate, utilizing exhaust air from the rivet gun.

Suggested by a Martin inspector, it's an example of how Martin men and women work together to speed production. And it's an example of the leadership that makes Martin first in the factory . . . first in the air!

1 *The worker picks up a rivet*



2 *inserts it in hole*

3 *drives it home*

YESTERDAY 3 OPERATIONS

TODAY ONLY 2 OPERATIONS

Lower pictures show how the new device works. (*Left*) Without taking hands from gun, worker inserts rivet waiting at end of the track; (*Right*) drives it home. Results: Thirty per cent speedup in riveting, aviation's tightest bottleneck. *Warplants desiring further information write the Glenn L. Martin Company, Baltimore, Maryland.*

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400,000 RIVETS hold MARTIN MARAUDERS together even when shot up like this one flying home over Tunisia. The new rivet feeder, by cutting riveting time thirty per cent, will speed victory by speeding output of MARTIN MARAUDERS, BALTIMORES and MARINERS.

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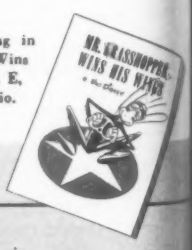
Abel Grasshopper, U.S. trained, seasoned, effective... doing more and more important missions on many fronts.

Overlooked, perhaps in the headline glories of lightning combat planes, and majestic battle-wagons of the air — but the maneuverable, sturdy Grasshoppers are writing new pages of glory with our armed forces. ☆ ☆ ☆ Official communiques emphasize the invaluable job these mighty atoms are doing, such as slipping in with supplies to stranded tank crews...or advance groups cut off from main columns . . . and getting out again from impossible take-offs — with vital information. ☆ ☆ ☆ The Grasshoppers have long established their dependability for instructing in artillery spotting and liaison training at home . . . and recurrent reports from fighting fronts make us modestly proud of the opportunity to emphasize again—and again — Aeronca — "First and Finest". ☆ ☆ ☆ Aeronca Aircraft Corp., Middletown, Ohio.

☆ ☆ ☆

A full-color book to delight the young in heart...Walt Disney's "Mr. Grasshopper Wins His Wings". Send 10¢ in stamps to Dept. E, Aeronca Aircraft Corp., Middletown, Ohio.



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FIRST *Grasshopper* FINEST

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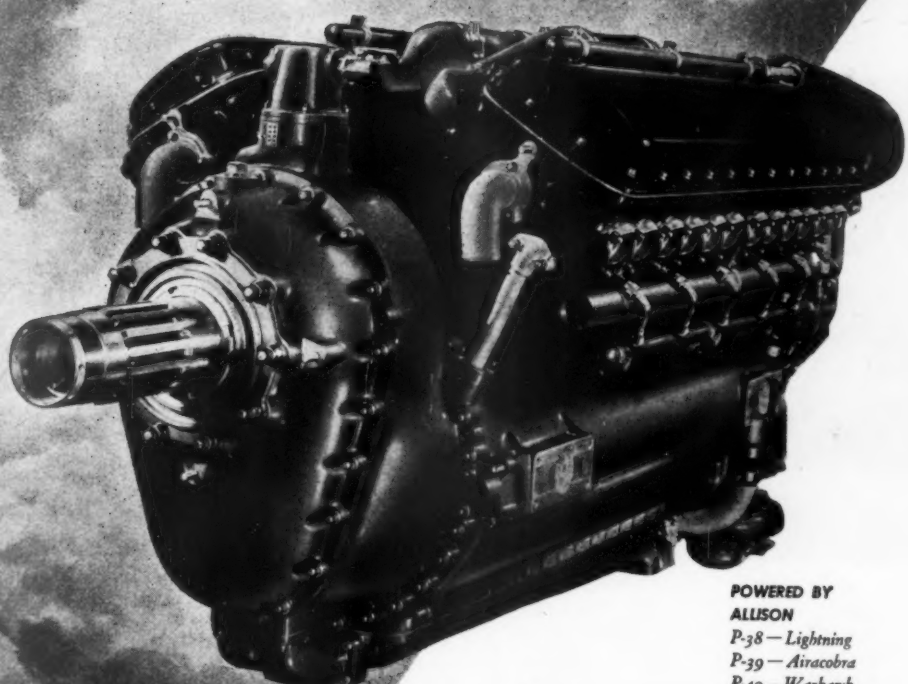
THE SKY IS NO LIMIT

There is only one way for any builder of an airplane engine to approach his job, and that is to make each part as fine as he is able to make it. ★ But in achieving this goal, Allison started with two special advantages. ★ One was the opportunity of drawing upon all General Motors' "know-how" in the perfection of manufacturing techniques. ★ The other was a privilege which had been ours for many years—the privilege of concentrating on assignments calling for high skill and precision in working with metals. ★ Perhaps we are aiming high, but with two such advantages it is natural our aspiration should be to seek to build ever finer aircraft engines.



POWERED BY ALLISON
P-38 — Lightning
P-39 — Airacobra
P-40 — Warhawk
P-51 — Mustang

LIQUID-COOLED AIRCRAFT ENGINES

Allison

DIVISION OF GM GENERAL MOTORS

Beechcrafts at work

No. 6 OF A SERIES

In 1939 the U. S. Army Air Corps, preparing for any eventualities, ordered a quantity of F-2 BEECHCRAFT twin-engine all-metal monoplanes, especially equipped for rapid and accurate mapping of large areas. Adapted from the commercial Model 18 BEECHCRAFT airline and executive transport design, these planes carried two multi-lens tactical mapping cameras mounted in tandem.

Their special task (in addition to photographic training and other duties) was to map large portions of the United States and its possessions which had never before been completely surveyed. Operating at high speed from great altitudes, the F-2 BEECHCRAFTS fulfilled this vital task long before December 7th, 1941, when its importance became obvious. . . . . This is one of many instances of Air Forces foresight and efficiency in which BEECHCRAFTS have been privileged to do their part.

The F-2 Beechcraft above the highest land masses on the North American Continent. Official photograph U. S. Army Air Forces

Beech Aircraft CORPORATION

BEECHCRAFTS ARE DOING THEIR PART WICHITA, KANSAS, U. S. A.

Medical enlisted men at Bowman Field, Ky., practice removing "wounded" men from air evacuation plane for trip to hospital.

AIR EVACUATION

By JOHN STUART

MORE than 50,000 men have been evacuated by air from combat areas since the war began. They were sick and wounded of our own and allied forces and sick and wounded prisoners of war. Many of them have been moved by air more than once, so this figure is no measure of casualties.

For what this means in humanity, in comfort to the stricken, you will have to go to the men at Walter Reed Hospital in Washington or Halloran General Hospital on Staten Island, or any other of the great medical establishments in the United States in which our men are gathered for the final treatments that will restore them, either to the military service or to a condition useful in civil life.

There's a boy at Walter Reed who got a shell through both hips, piercing two loops of his intestines, his bladder, and shattering the top of his femur as the shell emerged. He was hit on the way into Tunis.

"If he'd been hurt as severely in an automobile accident," said a veteran surgeon, "say up on the Hagerstown road here, he would be a lucky man indeed if he could have been rushed to a Washington hospital in time to save his life."

Yet that boy was picked up under the muzzles of the German guns. He says himself that the first five miles were the hardest. During that five miles he was carried first in a stretcher and then in an ambulance to the nearest flying strip in the hands of the Allies. Twenty minutes later, by airplane, he was in a field hospital where so much was done for him that his life was saved. Again he was carried by air to a great base hospital, far in the rear and away from possible bombing by the enemy. There he got that perfect post-operative care that would have been impossible had he been subjected to

Hospitalization is now but a few minutes away from the "wounded" flown back from "combat areas." This is practice at Bowman Field today but tomorrow it may be the real thing for these enlisted men and nurses taking special course in air evacuation service.

Blood transfusion during flight is demonstrated by Bowman Field nurse. Army surgeons credit new air evacuation service with reducing war mortalities to record low average.

a long journey in an ambulance train on the rails or in road ambulances.

For final rehabilitation, he was brought back across the Atlantic by air. A few hundred now are being brought home that way each month. The Army's surgeons hope that when the need arises, thousands per month can thus be transported *home*. For home, with relatives and friends near enough to help, means an awful lot to a hurt boy, struggling to adjust himself to a whole new way of life.

Important as this humanitarian aspect is, history will probably record this handling of the wounded by air as the great advance in logistics of this part of the war. For the airplane has not only made it medically more efficient to handle the wounded this way, it has saved the transport of unending quantities of food and medicine and supplies and doctors and nurses to the front areas where transport of any kind is at a premium for purely combat materiel and personnel. Literally, because the wounded have been evacuated more quickly and given better care thereby, thousands of more rounds of ammunition have reached the front, as well as thousands of more men to pour it into the enemy.

Our Air Forces give credit to the French for the beginnings of the evacuation of wounded by air. In 1917, a Dr. Chassaing, who was not only a medical man but a member of the French Chamber of Deputies from Puy de Dome, got a biplane with a single 180 h.p. motor, equipped as an ambulance plane. That same year it served valiantly in the evac-

Air evacuation nurses at Bowman Field, Ky., make last-minute check of "patients" as enlisted men begin loading litters into plane during training demonstration.

uation of the wounded from the Aisne front. But distances were short in the war in France and airplanes were none too plentiful.

So the record seems to show that the first real establishment for the handling of wounded by air must be credited to the French military surgeon, Major Epaulard, on Oct. 14, 1921. On that date, under his command, the French army organized the first "sanitary air squadron" of six specially equipped airplanes. The French were fighting that year of peace both in Morocco and in the middle east. The unit was used with great success in both areas. It carried wounded from the Atlas mountains and the desert to the great French military hospital at Marrakech. It carried wounded from the banks of the Euphrates across Arabia to the Mediterranean port of Aleppo. Before the year was over these planes had carried more than 700 wounded men.

So perhaps it is fitting that this great modern demonstration of mass evacuation of wounded by the United States Army Air Forces should have taken place in the French territories of North Africa. Of course it has been used in all our war theaters. In the Southwest Pacific, from island to island, it was practically the only way to get wounded out. But in Africa evacuation of wounded by air was competing with a road system of sorts and with at least one single track railroad. Small though such competition may be, the proportion of those handled by air to those handled by rail is so overwhelming that logistics students must take note.

The record shows that between November 8 (when our troops first landed), and June 1 of this year, more than 18,000 sick and wounded Americans, British, Germans and Italians were removed from our African front by air. They were removed with maximum speed and with maximum comfort. In all that time—and the comparison is not completely adequate because of the preoccupation of the single

(*Continued on page* 126)

Brig. Gen. David N. W. Grant, Air Surgeon, Army Air Forces.

A mass evacuation of "wounded" using Douglas C-47 transport planes is staged at Mitchel Field, N. Y. Litters will be set on portable arms along wall of fuselage.

PRELUDE TO FLIGHT

by
DONN HALE
MUNSON

A step by step account of how the Army's pre-flight schools condition minds and bodies.

1 Marching to the processing station, these "Eager Beavers" will soon be a hardened, disciplined group ready for primary training.

THE upperclassmen call them "eager beavers." They are officially on the Army Air Force books as underclassmen during 30 days of the toughest, finest training in the world during which young Joe Yankee undergoes a complete metamorphosis and comes out as prospective pilot material for Uncle Sam's Air Forces. The training program is correctly termed pre-flight and is divided into two periods of approximately four and a half weeks each, first of which is the toughest for men fresh from civilian life.

Chronologically, the following is the program which puts the boys in shape for primary flying school:

Once you have met the Army's standards for enlistment in the Air Forces and have passed the physical and written examinations, you are ordered to one of the huge classification centers.

Your introduction to Army life comes with a bang. You already have been a private, Air Force, unassigned, impatiently waiting your turn to be called up for service. Now you have orders to report to a certain station. You are appointed an aviation cadet and your pay and career start upward.

You'll find many other eager lads at your reporting station and it won't be long before you'll be entrained for your classification center. One of your group, usually a man with previous military experience, will lead the detail and Uncle Sam pays the freight, buying your ticket and your meals from home to station. Tired and dusty, hot and sweaty but eager to get going, you'll arrive at your station and tote your baggage to a big, sprawling building which is open 24 hours a day and which usually has a lighted sign over the door, reading: "New Cadets Register Here." That's you, mister!

You'll probably go to sleep to the whine of advanced trainers roaring through the night overhead. You'll think: how long, how long, before I'm up there with them? A long time, fellow—a long, hard time! At the crack of dawn you'll be turned out and once again you'll climb into your civilian clothes—for the last time. After a heavy breakfast you'll be marched to the processing station. Here you are practically reborn. Also, you'll meet your upperclassmen and be introduced to the class system. That meeting will really stand you on your ear. But you can take it. If you can't, you'll soon be found out and you'll learn you are not suited for the Army.

"Look proud, you misters, look proud! You're in the Air Forces now," the upperclassmen will yell as you try valiantly to march in step. Upperclassmen on processing detail will be in the big, clean building to answer your questions and keep you in line. Quickly you'll be assigned to a squadron and a group. In a long line, you'll stand before clerks and give them pertinent information about yourself and you'll watch with amazement the number of cards and forms that are filled out for you. You've already given the Army that information a score of times (and you'll continue to give it throughout your flying and fighting career). You begin to understand what the boys call the "red tape machine," a vital part of the system of handling thousands of men.

Now you begin to get the works. You strip, you take hot and cold showers. You are given a brief physical check and issued a barracks bag into which you pack your civvies. You are through with them for the duration "plus six months." Now you are in line for your issue clothing. It comes rapidly: athletic equipment, shorts, sneakers, sweat shirts, sweat trousers, sweat sox and supporter. Your barracks bag begins to take on weight as you stuff them in. You are dressed from top to toe. Underwear, sox, shoes, trousers, shirts, overcoat, blouse, woolens for winter, flight caps, service cap, insignia jewelry—everything you'll ever need, right down to shaving kit and tooth brush. You get an idea of where taxes go—in part—as you draw several hundred dol-

2 The Army's detailed record cards and forms are filled out as men are processed.

3 Next step before the routine physical check is to take hot and cold shower.

4 The "beaver" is uniformed. Tags are left on in case equipment does not fit.

lars worth of equipment. One set of uniforms you wear, the rest you pack in barracks bags. You don't remove labels or tags from your equipment because some of it may not fit perfectly. Also, there will be some among your group who will never get to wear a lot of their clothing. They'll wash out for various reasons, although here in pre-flight school your chances of getting to primary are excellent.

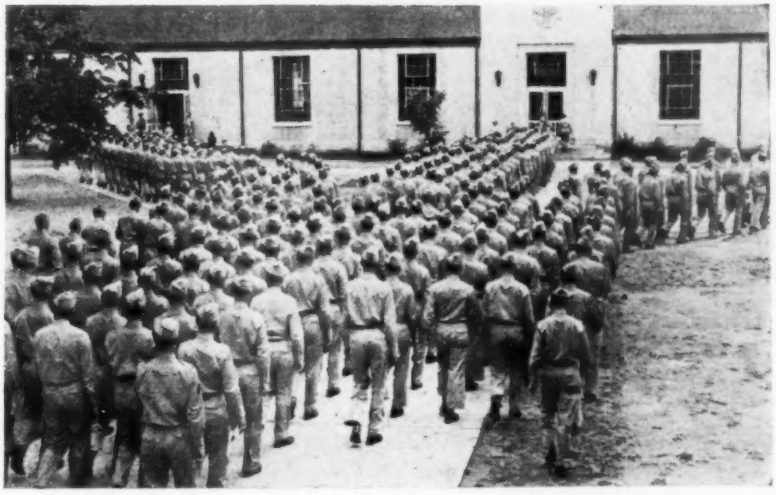
Once dressed and rigged properly, you'll be assigned to permanent quarters —at least you'll be in them for a week or so and in the Army Air Forces, where things move fast, that's *practically* permanent.

Your outfit, the squadron and group to which you'll belong during your stay in the classification center, begins to shape up. Within a day or so you'll have a chance to demonstrate your leadership ability. Men with previous service in the regular Army, military schools or with ROTC training will probably be your leaders. You'll take part in an informal competitive drill, taking turns giving commands. The best man wins, a commissioned officer making the decision.

Formed in squads and platoons, you'll march to mess in as smart a formation as possible. But those new uniforms with their shiny surfaces and your inability to make your left foot correctly follow your right bring a yell of "eager beavers," from the upperclassmen as you pass. But you are proud. You are on your way.

Now starts your tough physical exam. It's the W.D.A.G.O. Form 64. Your eyes, your heart, your lungs, every muscle, every bone, must be in good working order. You'll have the heart-rending experience of seeing boys washout and marked as unfit for flying duties. The percentage is very, very small, however, with possibly one or two out of several hundred failing to make the grade.

Once you have hurdled the physical exam, you'll have your mind probed by excellent psychological tests to determine



5 Formed into squads and platoons, the newly uniformed fledglings march to mess in as smart a formation as possible. Upper classmen chant "Eager Beavers" as they go by.

6 And at mess, the new men learn proper posture for lowly "beavers." Sit straight as ramrods on edge of chairs, eyes downcast at plates, don't speak unless spoken to.

7 Over the obstacle—but fast—and keep going! Pre-flight schools condition the bodies of candidates so that later they can take in stride the gruelling work of flying.

8 Pre-flight and primary training behind, those left of the original group of flying cadets are ready for their basic flight training in the low-winged BT-9.

whether you'll be a pilot, bombardier or navigator. The tests tell *plenty* and may take as long as two days. You'll go through in groups. Some of them will seem silly to you, others will make you wrinkle your forehead and you'll call up your knowledge of what you learned in grammar school to something you once saw in a Bob Ripley cartoon. It is virtually impossible to study for the tests because they are frequently changed and not of the type for which a man can sit down with a book and prepare himself. While for obvious reasons the contents of the tests cannot be exposed here, it can be said that the tests are not academically hard. They require good sound thinking which must be done rapidly and, above all, *common sense*. Army officers will tell you the lad with a grammar school education and a good brain has as good a chance as the college graduate.

Now comes days of impatient waiting. Perhaps you'll be sent to a small auxiliary field in "cold storage." Perhaps you'll draw a furlough. More likely you'll sit impatiently by until special orders are posted on the bulletin board in your squadron area. You'll watch that board like a hawk. Finally, you'll find your name on a list. You've been classified as either a pilot, bombardier or navigator. A great number of men are made pilots, while the brainy boys with quick fingers and highspeed brains who have a knack for mathematics will probably be bombardiers or navigators since nimble fingers for bombsights and expert manipulation of calculators and drift indicators are needed.

Once classified, you may go either to pre-flight school or be sent home on a brief furlough. The schools are big, the classes are crowded and the training is rapid.

You pack your bags and move fast. Now you settle down. You'll be lucky if you ever have time to smoke a complete cigarette in any one 24 hour period. You move into clean, well-lighted barracks. You'll share a room with five other potential pilots, bombardiers or navigators.

Here, too, the real underclass system starts. You'll walk the "rat-line" on the porch of your quarters at all times, never straying more than a foot from the wall and walking at strict attention, 140 paces per minute. You'll square every corner with flank movements, you'll never wear a cap in your room, you'll call everyone "mister" (except commissioned officers), you'll "sir" all upperclassmen. And you will balance yourself on the edge of your chair at mess three times a day and sit straight as G.I. ramrods, eyes downcast on your plates. You'll never speak until spoken to. Object of all this? First, to see if you can take orders as an underclassman; second, to see if you are the type who will be able to give orders when you go into the upperclass; and third, to see if you have what it takes to become an officer.

Your daily schedule, once you start ground school, will keep you hopping. Out of bed by five o'clock in the morning, you'll have a few minutes in which to shave and dress. Then you'll stand

(*Continued on page* 144)

SKIP-BOMBING

Staff artist Julian Krupa dramatically combines photos of B-26 "Marauder" and a Jap warship in portraying his conception of an actual skip-bombing attack.

by WAYNE GORDON

Planes attack at point-blank range with devastating results by using newly-perfected skip-bombing technique of Army Air Forces.

SKIP-BOMBING, the attack technique now used by the Army Air Forces with marked success, is comparable to riding a wild horse. Skidding, bobbing and dodging, the bombers roar in on the target. They level off a few seconds before releasing their bomb load. This eliminates a long, dangerous run, but it isn't pleasant flying—it's a rough rider's job. But, according to the latest Air Forces reports, its results are very satisfying.

Skip-bombing, basically, isn't new with the Army. What is new, though, are the techniques. Almost two years ago, in January, 1942, tests were ordered at Eglin Field, Fla. Orders were to prove or disprove that low altitude bombing against tanks and other targets would be more successful and result in fewer losses than other types of attacks.

For several months these tests were carried out. All types of aircraft from *Flying Fortresses* and *Liberators* to light pursuits were used. Finally, a report was made. In effect, it said:

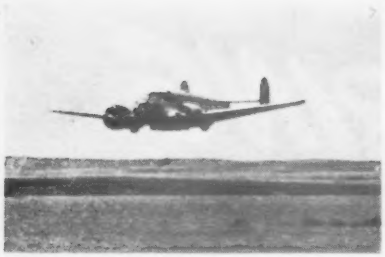
"Skip—or masthead—bombing is better than torpedoing because it offers better security and greater accuracy. Prior to dropping the torpedo, the plane must maintain a 20 to 30 second level approach at slower speeds and during that time offers a good target for the enemy gunners.

"On the other hand, the skip-bombing approach can be lower and the speeds can be much higher at the maximum sea level speed of the attacking airplane. The skip-bombing plane needs only a two or three second straight approach in which to sight and release the bombs. Thus, the danger to both the pilot and plane in skip-bombing is much less."

While all types of aircraft were used during the tests, it was found that a highly maneuverable, speedy plane was safer and more economical. Fighters as well as medium bombers were found to meet these specifications.

There is another economy over high level bombing. The plane on a skip-bombing mission needs no bombardier and his place in weight can be taken up by additional bomb load or more fuel. The pilot releases his bombs from the cockpit. The plane itself aims the bombs, practically at point-blank range. The speed of the plane hurls the bomb directly into the target's side.

During the tests, two methods of attack were developed. One was for the



1. Skip bomb leaves practice bomber.

2. Bomb strikes surface of water.

3. Bomb skips, heading for target.

4. Bullseye! A direct center hit.

destruction of ships or land targets having little or no armor and the other for targets such as battleships having very heavy armor.

At the relatively unarmored targets, bombs weighing between 500 and 1,000 pounds are released at extremely low altitude (probably under 50 feet) and at maximum speed. When these bombs are dropped, they are so aimed that they will not strike the water but will crash directly through the side of the ship. A delayed action fuse then explodes the bomb.

This delay in explosion, it was found, gives the attacking aircraft time to cross over the target and to be safely out of the detonation area when the charge goes off.

Against heavily armored ships, it is something else again. The attacking plane carries perhaps a 2,000 pound bomb. Released at a slightly higher altitude, the bomb hits the water short of the target. If the aim and releasing of the bomb is true, the bomb will not skip but will travel under the water, exploding under the keel of the ship, an effect producing great damage and possibly breaking the ship's backbone. It is an effect long and so far fruitlessly sought by torpedoing. As in the bombing of an unarmored or lightly armored ship, the 2,000 pound bomb also has a delayed action fuse, allowing just time enough for it to reach the soft underside.

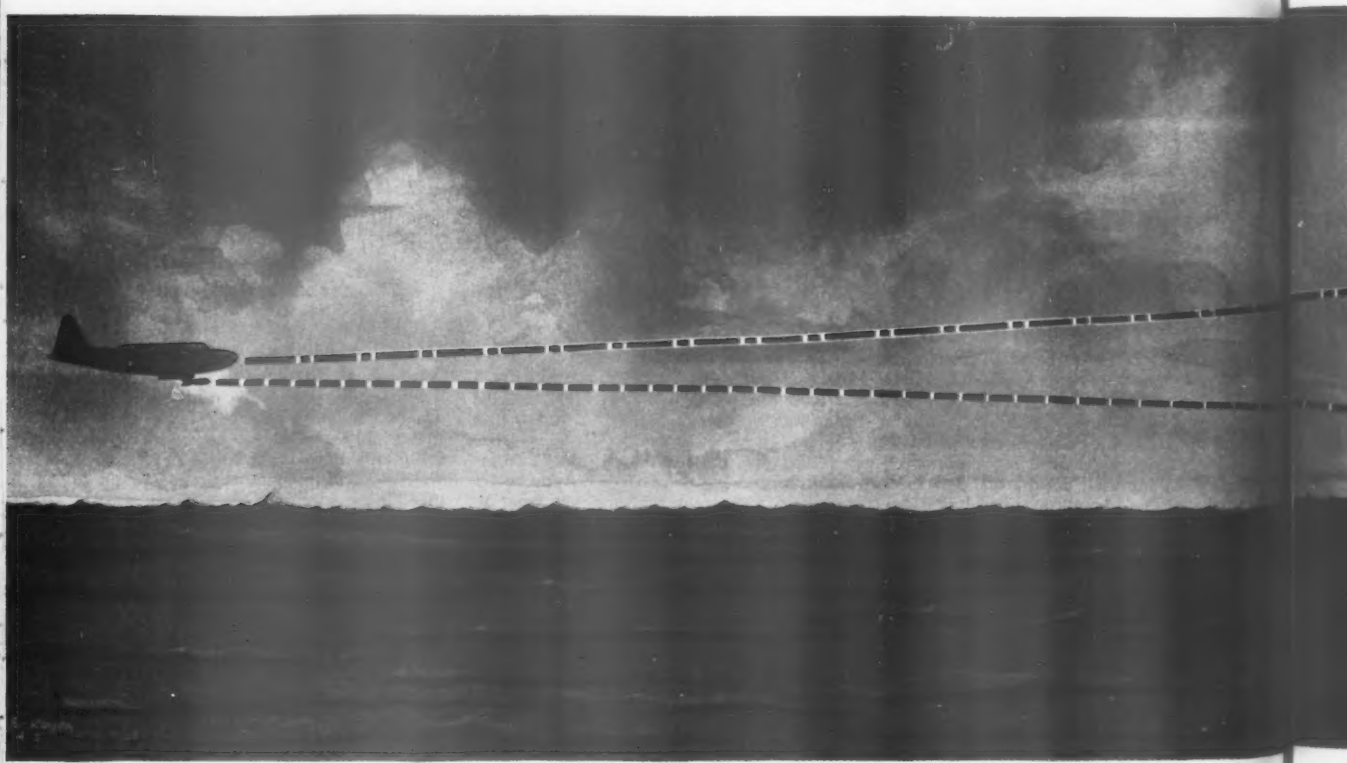
These results were reported to all theaters of war and special squadrons were brought to Eglin for training. A few crews, almost immediately after the tests were proven practical, were trained and shipped to active theatres.

Soon reports came back of skip-bombing results. From the Southwest Pacific came glowing reports of successes. But, it was added, many of the light and medium bombers were coming back badly shot up.

It was then decided to increase the forward fixed fire of the attacking planes. With these additional guns, recent attacking craft have been able to put down such a hail of lead that defending antiaircraft gunners were forced to seek cover while the attack was thrust home.

From the same combat zone also came

Masthead bombing without the skip. If the skip is too high bomb may jump completely over target, hence bomb is aimed at side of ship.



reports stating that while big bombers were somewhat successful, the lighter bombers were proving best for this type of attack. It has generally been deemed best to use the bigger craft only on long range missions where it is impossible for light bombers to reach the objectives, and then, generally to restrict the heavy bombers to high-level, precision bombing tactics. They are too valuable to risk below the range of effective antiaircraft fire.

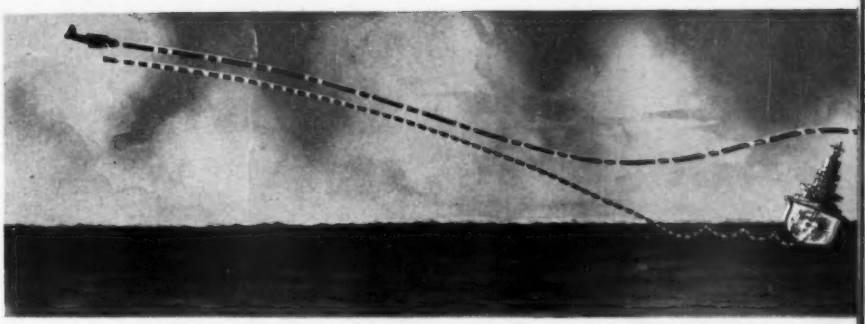
B-26's and B-25's were found most successful in the lower Pacific area. Attacking in pairs, one would strafe the target from stem to stern, diverting the antiaircraft gunners, while the second came in for a bomb run. These planes made their attacks at speeds above 250 m.p.h.

From Africa came reports of skip-bombing missions during the period from January 13 through April 16, 1943, in which 105 missions were flown by B-25's and B-26's. During these missions, 16 merchant ships were sunk and 18 damaged severely and one cruiser was damaged severely. Sixty per cent of the bombs released in the sea attacks resulted in direct hits and 15 per cent were near misses.

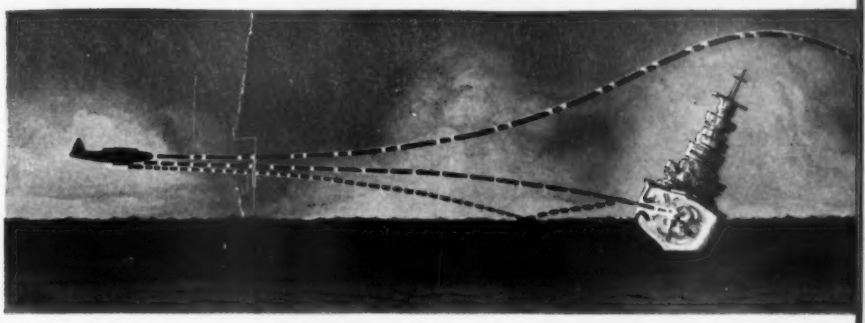
The fighter escort varied with the missions, but there was always one fighter to each bomber. Often there were 16 fighters to six to 12 bombers. The fighters were used mainly to keep fighter opposition occupied while the bombers went in to perform their missions.

Results of these raids were called excellent by African commanders. How-

(*Continued on page 142*)

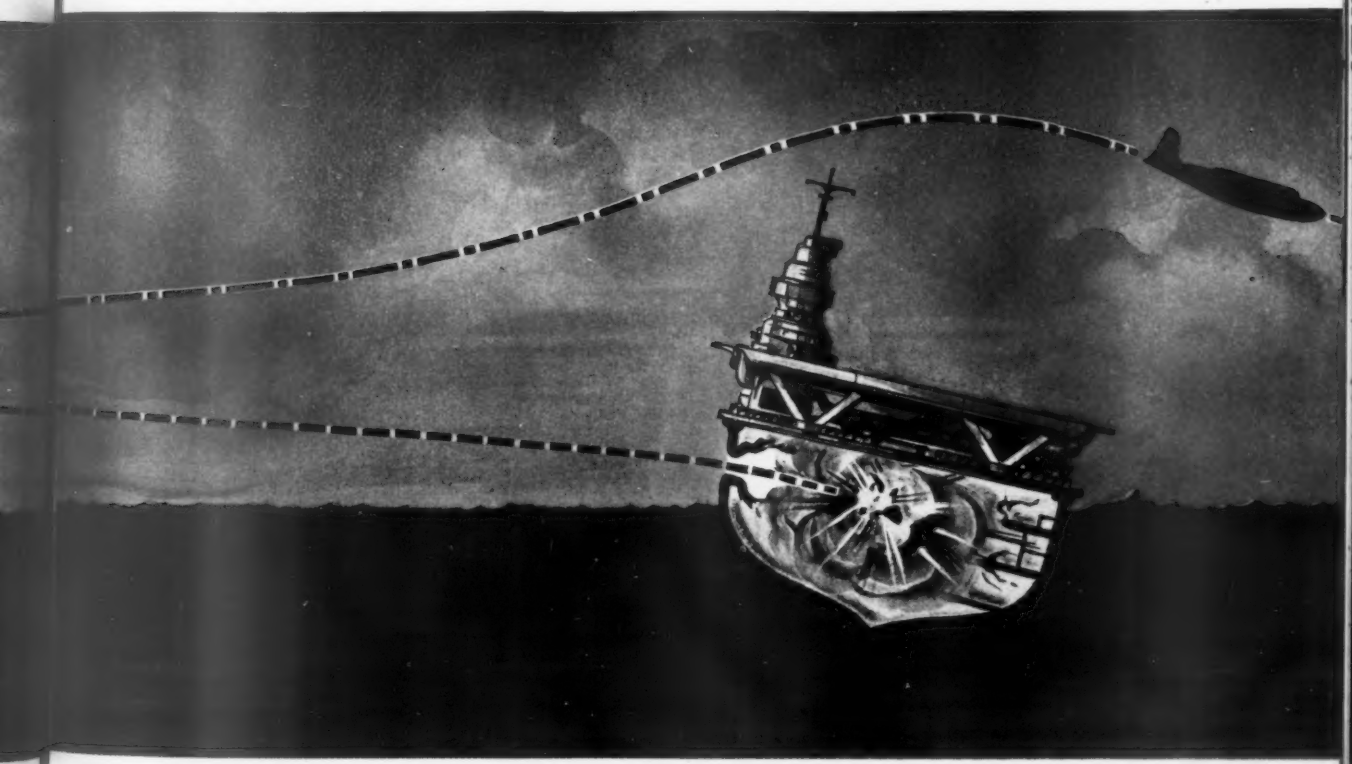


For heavily armored craft, the bomber comes in at a slightly higher altitude than for ordinary skip-bombing. The bomb hits at a distance from the target and bobs under surface of water, exploding against ship's underside.



True skip-bombing, used against lightly armored or unarmed ships. The bomber comes in at maximum speed at about 50 feet altitude. Aiming through his machine gun sight, he lines up on ship's side—hoping to have bomb penetrate interior.

A tactic such as this would be used against lightly armored or non-armored target. Delay in explosion permits plane to clear the ship.



Ready for installation, the recoil unit adds only three pounds to the weight of .50 caliber aircraft machine gun.

STEADY AIM!

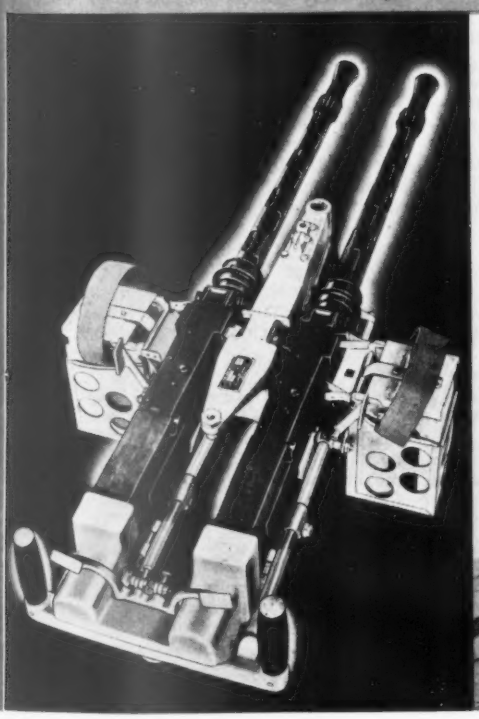
Bell's machine gun recoil damping device gives fixed rigidity to free guns.

ONE reason for the remarkable marksmanship of American aircraft machine gunners has been a hydraulic recoil damping device manufactured by the ordnance division of the Bell Aircraft Corporation, it has been officially announced. Used on both .50 caliber and .303 caliber machine guns, and known as the Bell machine gun adapter, the unit absorbs the shock of machine gun recoil and enables the gunner to hold steady on his target. The device was developed by engineers of Bell Aircraft in co-operation with Army and Navy ordnance experts. It is a portable, lightweight cradle consisting of two steel tubes and a hydraulic absorption unit. It attaches to a .50 caliber aircraft machine gun by only two bolts. The adapter adds less than an inch to the overall dimensions of this size gun and only three pounds to the weight when conventionally mounted. Bell adapters are in use on Army *Flying Fortresses*, *Liberators*, *Mitchells*, and *Marauders* and on Navy Douglas dive bombers, torpedo planes, and Consolidated Vultee and Martin patrol bombers.

The gunner in the tail of this North American B-25 "Mitchell" can aim his machine gun straighter because the shock of recoil has been taken up by hydraulic absorption unit.

Army waist gunner in a Martin B-26 "Marauder" bomber lines up a target with his .50 caliber machine gun equipped with Bell hydraulic recoil damping adapter. Upper left shows adapter (accentuated) mounted on single .50 caliber machine gun. Conventionally mounted, the unit adds only one inch to overall dimensions of gun.

Smaller guns pack a kick, too. Here the recoil damping mechanism has been adapted to these twin .303 caliber aircraft machine guns.



Twin rear guns on Douglas A-20A would buck so wildly they could hardly be aimed properly without an efficient recoil damping mechanism such as the Bell unit. This has overcome the chief difficulty in using guns which are swung freely on a flexible mount.

"SEA BIRDS"

Coast Guard pilots receive instructions on location of convoy they are to protect.

By ROGER WILLIAMS

ONE of the least publicized services waging daily battle in the fight against the Axis is the small but effective aviation arm of the U. S. Coast Guard. The Coast Guard "Sea Birds," as its pilots are known, have not been interested in publicity. They have been busy performing their wartime job as smoothly and efficiently as possible.

Stalking an Axis submarine and bombing it into oblivion; escorting one of Uncle Sam's huge convoys through enemy infested waters; rescuing members of a torpedoed merchant ship, or transferring an injured or ailing seaman in choppy waters and flying him to a hospital ashore is all in the day's work for the pilots and men who comprise the crews of Coast Guard planes.

Coast Guard aviation has easily shifted from its former role of maritime policeman, chiefly concerned with the preservation of life and property upon the seas, to its new role of active participant with the Navy in the struggle against the Axis powers.

Most important mission of the Sea Birds is to assist the Navy in every possible way in the coverage of convoys and anti-submarine patrols. Along the eastern coast there has been considerable activity by the Coast Guard, and instances can be cited of at least two clearly established submarine sinkings. No doubt there have been many more.

On the west coast, as well as in the east, daily patrols are made by Coast Guard planes, operating in conjunction with Navy and Army planes, Navy blimps and Coast Guard cutters. Japanese submarines in the Pacific, at least within striking distance of the coastline, are few and far between. Not since the day a Jap U-boat fired on United States soil for the first time off the California coast —and then later repeated the trick, via a submarine-launched plane, off the Oregon coast—has the west coast been threatened by enemy submarines.

In contrast to activity in the east, this lack of excitement has begun to wear slightly on pilots and men stationed at western Coast Guard aviation bases. This is particularly true at the San Francisco station.

From the commanding officer on down through the ranks, these men are anxious for more action. The pilots, all Navy trained and graduates of Pensacola, can see no good reason why they shouldn't be flying fighter planes somewhere in the Pacific.

Comm. Norman M. Nelson, energetic commandant of the San Francisco station, says rather unhappily:

"I haven't seen hide nor hair of a Jap, or anything resembling one. Our job here is undoubtedly important, but just look at this batch of requests. They are from men who wish to be sent out into the

The Coast Guard's aviation unit is doing its wartime job with little fanfare, but the enemy is aware of its striking power.

Lethal depth charges snugged up under the wings of these Coast Guard planes menace enemy subs in coastal waters.

combat zone. And my own is among them.

"But please don't misunderstand. I know that what we're doing here has its place in the safeguarding of our coast line, and in the event the Japs should ever strike San Francisco or any other city along the west coast we'll have our work cut out for us. But it is difficult to hold back men who, because of their training, feel they should be playing a more vital role in this war."

If Commander Nelson had his way, the Coast Guard would expand its duties to include fighter squadrons. He believes the Guard should have its own fighting unit of Sea Birds in the combat zone, just as the Army, Navy and Marine Corps, whose men are distinguishing themselves on the fighting fronts of the world.

"There's nothing more important than the war itself, and out there," explains the commander, with a wave of his hand in the direction of Tokyo, "is where big things are being accomplished. That's where Coast Guard pilots and men should also be represented."

The yearning for combat by men of Commander Nelson's caliber is understandable. Yet the importance of Coast Guard aviation at home cannot be stressed too strongly.

Most active of all coast guard bases is undoubtedly the Elizabeth City, N. C., Air Station, under the command of Lieut. Comm. R. C. Burke, located not far from Cape Hatteras. There's a bend in the coastline at Cape Hatteras that all ships must traverse to reach their destination. That makes this a perfect hunting ground for German submarines.

Two enlisted men of the Elizabeth City station, Harold V. Booth, and Frederick J. Denio, perfected the "food bomb," which is dropped to survivors of torpedoed ships in much the same way as the Coast Guard, prior to the war, would drop a storm warning to fishermen who

An Atlantic convoy heads eastward under the protecting wing of a Coast Guard plane.

Lowered from cutter, a Coast Guard plane prepares for flight across Greenland's snowfields in the distance. "Sea Birds" have rescued many stranded airmen in this area.

lacked radio communication ashore. This food bomb resembles a depth charge and has a soft concrete cap which disintegrates on contact with the water. Its contents include seven cans of water, a first aid kit, a pint of whiskey, two rations, several packs of cigarettes and matches.

Best evidence of the adaption of Coast Guard aviation to the war effort might be found in an analysis of its activities. While figures up to the present writing are not available, a little simple multiplication on the part of the reader will paint a clear picture of what has been accomplished since the war began.

In the period between the start of hostilities on December 7, 1941 and June 30, 1942, Coast Guard aviators flew 23,442 hours during which 17,842,231 square miles were searched and patrolled while 2,245,357 miles were cruised. The normal patrol routine is exacting and tiring.

During this same period, there were 6,032 patrol flights on which 63,233 surface vessels and 12,951 planes were identified. Compare these figures with a total strength of about 100 planes and 107 pilots, you will readily see what a real job the Coast Guard has been doing, and still is doing today.

All these figures can be enlarged upon considerably for corresponding periods, and that goes for the number of planes and pilots. The pilot personnel has been boosted and, needless to say, new equipment has been provided for these men to fly.

Incidentally, the patrols of the Coast Guard are never really routine. Often a small boat of survivors, victims of a torpedoing, is sighted. The first six months of 1942 found the Coast Guard recording 310 assistance flights, while 508 survivors of torpedoed vessels were located and surface vessels directed to their rescue. You can do a little multiplying here, too, if you want to be brought up to date.

One of the most noteworthy offshore rescues was carried out by Lt. D. O. Reed, his co-pilot, Ens. V. C. Tully, and his crew of J. E. Horwath, D. C. Denford and J. H. Rodgers, operating from the Biloxi, Miss., Air Station.

Lieutenant Reed and his crew returned ashore with 21 Norwegian seamen, one with a broken back and several others badly burned, who had been adrift in the Gulf of Mexico after their vessel was sunk by a German submarine. Although his plane was only equipped to carry nine passengers and already had a six-man crew and 600 gallons of gasoline, Lieutenant Reed took all survivors aboard, placing them as far forward as possible. The plane was exceedingly tail heavy and had only 40 knots air speed when she became airborne.

Two of the most remarkable rescues by Sea Birds were those made by Lt. John A. Pritchard, Jr., 29-year-old Coast Guard pilot from Burbank, Calif., who flew the treacherous air lanes of the North Atlantic on war patrol.

Operating an amphibian plane, Lieutenant Pritchard covered thousands of square miles on reconnaissance flights and saved five airmen whose bombers were forced down on Greenland's frigid wastes—three members of a crashed Royal Canadian Air Force bomber and two of a U. S. bomber.

Later, in an attempt to rescue a third and unidentified airman who survived the crash of the bomber, Lieutenant Pritchard, his radioman, Benjamin A. Bottoms, and the Army aviator disappeared.

Lieutenant Pritchard's initial landing to save the two U. S. Army flyers is believed to have been one of the first successful landings and take-offs on the Greenland ice cap. The Coast Guard Sea Bird flew off the ice cap a second time in rescuing the third Army aviator, but the plane crashed during the return trip.

Reconnaissance flights led to the discovery of the wreckage of the Coast Guard plane, but aerial observers were unable to detect any signs of life in its vicinity.

Coast Guard planes used on patrol in-

(*Continued on page* 139)

Aviation in Duotone

A selection of distinctive aviation photographs appears in the section facing this page.

"SEA BIRD" PATROL

SPILL THAT 'CHUTE

SILHOUETTE

HANGAR FRAME
136
136

ROUTER

WOMAN WAR WORKER

OUTDOOR OVERHAUL

HANGAR HEROES

Especially ingenious is this portable device by which Army Air Forces' technicians test the accuracy of altimeter, motor speed indicator, tachometer, gyro, vacuum pump and air speed indicator.

by KURT RAND

Army Air Forces' mechanics approach each repair operation as though they were going to fly the planes themselves.

THE Army Air Forces' "heroes of the hangars"—the aircraft mechanics—are much like the linemen of the football team. The ball carrier gets the cheers, but the real fan knows the men up forward made the run possible.

Literally and figuratively these enlisted men and noncommissioned officers of the Army Air Forces ground section are the "linemen."

The "Four Horsemen" of the flying backfield — bombardier, navigator, pilot and gunner—carry the ball, but the way is cleared by the sturdy stalwarts of the flying line, mechanics, armorers, radio technicians, instrument maintenance men and weather forecasters. There is nothing more useless than airplanes on the ground; these "linemen" make it possible to get them off the ground and into the air with speed and efficiency.

At the Santa Ana, Calif., airdrome of the West Coast Army Air Forces' Training Center, administrative headquarters for all Army flying schools in the west, officials estimate that every plane in the air requires 10 men on the ground. And that's a conservative estimate.

At this airport, directed by operations officer Maj. Alan L. Blum, every ship has its own crew, varying from two men for the Ryan *Recruit* primary trainers to three or four for the heavier basic and advanced trainers and a dozen for the big transport and combat planes. In addition there is a general "alert crew" which services visiting planes and provides manpower to cover sickness, leaves and special jobs.

The day shift starts to work at 7:30. Every morning there's an inspection of all vital zones in each ship. The motor is "revved up" while trained ears note all significant sounds. If the plane takes off during the day, there's another pre-flight check-up (but much more thorough). When the engine has run 25 hours or when 30 days have elapsed, there's a more comprehensive inspection. At the end of 50 hours or 90 days there's another, still more rigid. The 100-hour mark calls for more examinations, and the 400-hour index is the signal for a complete overhaul, with engine removed from plane.

Each mechanic on the flying line is an expert, but still his word is not enough to give a ship air clearance. Every operation is triple checked: first by the man who does the work—then by his crew chief—finally by the flight inspector. Every process is recorded on printed forms and initialed by those who attest its correctness. Each type of inspection has its own carefully worked out plan. The 50-hour examination, for instance, lists 97 individual parts and functions of the plane which must be tested. When you reach the 100-hour and 400-hour stages, the number of operations mounts into the hundreds.

Major aspects of the inspection charts are transcribed on a huge wall board in the hangar. The status of each ship is

Planes need repairs and so do the tools used to repair them. Many mechanics think so highly of their equipment they purchase their own tool kits and guard them carefully.

Little "tugs" looking like miniature tractors tow big planes at the Santa Ana, Calif., base of the West Coast Army Air Forces' Training Center. When the teletype serves notice that a plane is arriving, the "tug" goes out to haul it to its anchorage.

listed here daily, giving a flyer all the vital statistics at a glance. If the crew chief signs his initials after the number of the plane, it is ready to go aloft. If he marks a red cross, the plane is not to be flown. If he makes a straight red line, then the ship has some minor defect which must be fixed but which will not prevent necessary flying.

Each ship crew has its own chart on a master bulletin board, wherein its efficiency rating is apparent at all times. Percentage graphs are posted on plane maintenance and on the ingenuity, military discipline, mechanical aptitude and general conduct of each member of its crew. Any individual who falls behind is certain to be jacked up by his teammates.

When the teletype pounds out its message of a visiting ship arrival, the "alert" crew swings into action and gives the guest just as much service as home crews afford their own special charges. One man piloting a "tug," which looks like a miniature tractor, drives to the runway and leads the new plane to an anchorage where another mechanic with a red flag waves it into exact position. A gasoline truck rolls up and services the ship immediately. A staff car is available to take the guests from flight line to office.

There are four "echelons of service" for Army aircraft. The first is simple servicing on the flying line: gasoline tanks filled, windshields wiped, spark plugs adjusted, oil changed, filter cleaned. The second consists of minor repairs on the line with hand tools. The third demands use of heavier stationary equipment in the machine shops, or in the case of field operations, the portable canvas

(*Continued on page* 146)

The presidential emissary, surrounded by crew members, shakes hands with Captain Golien, pilot of the C-54 used on the flight.

FLIGHT TO MOSCOW

by E. JAY DOHERTY

How Joseph E. Davies' second "Mission to Moscow" was accomplished capably and swiftly by plane and crew of the Air Transport Command.

BEHIND the steel doors of a hangar at Washington National Airport a small group of civilians climbed into the cabin of a four-engined Douglas C-54 transport plane behind a line of nine crew members dressed in the uniforms of the Air Transport Command. They boarded inside the hangar to preserve the utmost secrecy as to the identity of a statesman carrying a sealed briefcase. A tractor dragged the camouflaged plane to the ramp. One by one the four propellers began their powerful hum and the plane taxied off on the start of one of history's most unusual transport flights.

Passengers aboard that plane May 7 were Joseph E. Davies and his party, consisting of a physician, a valet, a Naval aide and a State Department official who speaks Russian. Their destination: Moscow.

Up forward was one of the crack crews of the ATC. Capt. Waldon G. (Swede) Golien, former chief pilot for TWA requisitioned for the duration by the ATC, sat at the port controls. With him were First Officer Bob Prescott, veteran AVG pilot; navigators Peter Redpath and George Hart; radio operators Bill Davis and W. R. McGrew and purser Ernie Belshaw. Completing the crew were mechanics Al Brick and Ted Vreeland. All were aviation veterans and had made numerous ocean crossings for the Air Forces.

They knew little in advance about the flight until they read their orders. They had been instructed to make the trip as foolproof as possible and had loaded more than 370 spare parts in the cargo bins. But because of the quality of their equipment, they needed to replace only two tire valves and some sparkplugs during their more than 25,000 mile trip.

Before their return to Washington after

A Douglas C-54 Army transport carried Mr. Davies, his party of four and nine crew members on the 25,000-mile diplomatic mission.

approximately 140 hours of flight they had crossed oceans, deserts, mountains; they had learned a few words of Egyptian and of Russian; they had seen fertile fields and desolate territory that could not nourish life; and one of their members had been greeted personally by Premier Joseph Stalin.

The story of Davies' mission cannot yet be told. What message he carried to Stalin and what answer he sped back to President Roosevelt few men know and none will say. But the story of the crew on that historic flight can be narrated except for facts that might aid the enemy. The exact route cannot be revealed, the state of the airports they used and the facilities they had for safe navigation must be withheld, but what can be revealed is nevertheless a story worth telling.

Let Swede Golien tell you about it:

"So far as the operational reports go, it was a routine flight. We encountered no mechanical trouble, thanks to the efficient work of Brick and Vreeland, who labored like beavers to keep the plane in tip-top mechanical condition.

"The passengers and the crew saw to it that we had no delays en route, except an unavoidable one because of weather. The only deviation we made from our flight plan was on the last leg, when we had to avoid heavy weather.

"And let me say that I can't praise the crew too highly. As captain of the flight, I felt throughout the trip that I was extremely fortunate in having the best flight crew to be found anywhere for such an operation—and the best plane, for that matter. I had worked with some of the crew for years with TWA Airlines. With such a combination I didn't see how the mission could fail.

"There was nothing unusual about the first part of the trip. Natal, Belem, West African bases and Khartoum were well known to most of our crew. Our first deviation from routine was during a stopover in Egypt, where we were fortunate in being able to see the temples and other ruins that date back thousands of years. Pete Redpath, our chief navigator, was particularly enchanted with a room in a Karnak temple. It was a rectangular chamber, containing two statues, evidently raised in honor of the sun god and moon goddess. Directly above the statues were small ports in the roof. On one day a year the sun shines through and illuminates the head of the sun god; one night a year the moon spotlights the goddess of the moon."

Bill Davis cut in and said, "I've been a student of Egyptian history for many years and I got a big kick out of that visit. After we had a good look around we went on to Cairo, where we had an opportunity to go through the pyramids, ride camels and go through some regular tourist sight-seeing.

"We had just one casualty on the trip," Davis continued. "Bob Prescott, who got six Japs while with the 'Flying Tigers' and not a scratch to show for it, and who has made air crossings of the North and South Atlantic without frostbite or sunstroke, showed up one morning with the sweetest shiner you'd want to see. He pulled that old gag about being hit by a street-car and we nearly laughed him out of Egypt. But MacGrew turned out to be an eye-witness, and sure enough Prescott did get hit by a street-car. Is that irony?"

"Yes, Bill, but he wasn't the only casualty," Swede put in. "Remember the night you slept under a window swung in over your bed? You had a dream and sat up suddenly with a thump and started fighting with the window. That was funny. But to get on . . .

"There are many things we'll never forget, but the one impressing me most was coming up along the Volga to Stalingrad and seeing the ruins of war. It was a sobering experience."

"Let me tell him about the smashed Nazi plane," Bill interrupted. "The bank of the Volga at Stalingrad is steep, nearly like a wall, and we saw a German bomber crumpled right on the bank, almost in

Stalingrad proper, but not quite. We thought it sort of symbolized the Nazi siege. They almost made it but not quite.

"Later it was a real emotional experience to me to stand in the basement of the house where the German generals surrendered to the Russians and then to walk out into the street in front of the house where there's a memorial to the Unknown Soldier of Stalingrad. Mr. Davies laid a wreath there and spoke briefly."

Al Brick, who was fooling with a stack of foreign money, picked up the narrative. "This was where we had our first introduction to a Russian meal. We were dusty and dirty and they invited us to have tea. Tea turned out to be a 15-course meal and we could leave only after an hour by insisting we had to return to the plane and Prescott."

"You see," Bill said, "Mr. Davies suggested we leave a guard with the plane in addition to the Russian soldiers because of all the important confidential material he had in it. We drew cards for the job and Prescott turned up the three of hearts."

"If Stalingrad was the deepest emotional experience of the trip," Swede went on, "the most impressive moment for me occurred during the big banquet given Davies by Stalin, which I attended. All the guests were gathered in the reception room of a house in the Kremlin. You heard the pleasant hubbub of a lot of people talking and laughing. Suddenly there was utter quiet. I looked toward the door and Stalin was walking into the room. He dominated the room as he walked along, shaking hands or nodding or smiling at every one.

Premier Stalin's reply to President Roosevelt was sealed in this brief case.

"He came up and shook hands with me, a good solid hand-shake. You get a feeling you're in the presence of a very strong character. He said something that probably meant 'how do you do' and went on. He has a quiet personality, not exactly dominating, but a personality that overshadows others present. When talking he stands stolidly, his hands at his sides, very much at ease. His facial expression doesn't change much except when he is amused—and then he grins.

"Dinner was held in a large marble-walled room lined with columns of malachite, a semi-precious stone in Russia. Placques around the wall picturing Russian historical personages were framed in gold and the frames were studded with what seemed to be jewels. Large crystal chandeliers hung from the ceiling and more crystal lights shone from lamp stands.

"Stalin sat in the center of a long table, with Mr. Davies on his right and the British ambassador, Clark Kerr, on his left. Directly opposite was Molotov, next to Admiral Standley. There were many other important Russian, British and American persons there. The dinner, like all those we had in Moscow, was astonishing in its lavishness and quality."

Davis interrupted. "Did you ever get Stalin's signature on your 'Short-Snorter,' Swede?"

"No. I thought of it, but there were others waiting to meet him and the time didn't seem opportune. I didn't see him again."

Al Brick finished pasting a 30-ruble note on his long "Short-Snorter" roll. It had signatures on it of Davies, Walter Duranty, Maxim Litvinoff, Quentin Reynolds, Eddy Gilmore, and the members of the crew. The bills were of Brazilian, Persian, Moroccan, Algerian, English, Egyptian and Canadian denominations, as well as American, and American invasion money.

Davis took up the story. "Swede was pretty busy most of the time conferring with Russian experts on the route home and otherwise taking care of business, but

(*Continued on page* 135)

The crew members were treated as guests of the Soviet Union and saw such sights as captured German planes in a Moscow square.

By special arrangement this monthly feature appears simultaneously in FLYING and "The Aeroplane" London

THE war has entered a new phase. The United Nations today are on the offensive. The tide has turned. And we in America now come to the startling realization that our democracy has been saved by a set of fortuitous circumstances.

Because Hitler failed to follow through after Dunkirk, because the Japs failed to march in after Pearl Harbor, because the aviation industry of Britain and America adopted the principle of day-to-day development and improvement of aerial combat craft to meet *all* types of aerial warfare, because the air strategists of Germany failed to foresee the necessity of fighting a defensive war, the victorious conclusion of this conflict seems to be in the not too distant future.

Perhaps it is a surprise to many people to realize how many mistakes Hitler has made in his war preparations. First, he committed the unpardonable error of guessing wrong as to where the war would finally be fought and won. Secondly, he made the unpardonable error of under-rating the ability and strength of his potential enemies. Thus, he approached his aviation problem with the idea that he could freeze his designs, assuming that his designs, carefully developed in the years before the war, would suit the everchanging strategy of the war as it progressed. He guessed wrong because he thought it would be a blitzkrieg; a lightning war—fast, furious and quickly ended. It wasn't a blitzkrieg. And after he had completed the phase of overrunning enemies who were ill-prepared for his long-planned attack, he then found himself confronted with the problem of waging war in territories that had not been included in his original plans. These territories, in many cases, were overseas, and he had not prepared for an overseas war. His navy, like his air force, did not consist of all types of weapons, but had a predominant accent on submarines and small, fast craft essentially defensive in character. He had assumed, in developing the "pocket battleship," that he had a new formula which rendered obsolete the older forms of naval weapons. But the *Graf Spee* proved to be vulnerable to craft of inferior fire power intelligently directed by officers capable of making use of new and improvised tactics which the Germans had not foreseen.

His aviation materiel had been designed to co-ordinate an offensive with his highly developed army; and furthermore, against nations which he assumed to be weak defensively in their own aircraft. It worked fine while it lasted. Against Poland his aerial reconnaissance, followed by short range bombing, destroyed the enemy's limited air force and allowed him methodically to trap the Polish armies and destroy Poland's centers

The author, J. Carlton Ward, Jr., is president of the Fairchild Engine & Airplane Corp.

of population. The destruction of Warsaw demonstrated a new concept of total war.

But for the most part his fighter planes were weak in defensive armament; his Stukas—one of his horror weapons, with its frightening scream and deadly fire and destructiveness against helpless congestions of ground troops, civilians and supply lines—looked very well when confronted with no formidable aerial or modern antiaircraft opposition. But they were slow and later proved to be so vulnerable that they now are practically obsolete. His bombers were small, badly armed, short ranged and weak defensively. Here again he had thought of a continental war, with his enemies close to his own air fields and supply lines. Nazi industry had been set up on the theory of static designs and production in quantity, without excessive interference from design modifications. Only recently has he developed the Focke-Wulf FW-190 and his four-engined long range bombers. He still uses what is left of his Junkers JU-52's, a slow and vulnerable transport, for aerial supply lines along with many of the older designs with which he started his blitzkrieg.

And now we learn, through Intelligence reports, that he is frantically diverting his diminishing productive capacity from the construction of bombers and offensive aircraft to the construction of defensive fighters, because of the aerial onslaught of the Allies on his homeland.

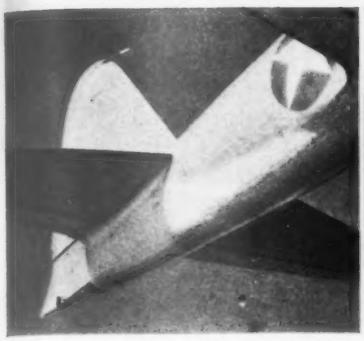
It is an old axiom of war that to be prepared, an efficient nation must have the best of *all* classes of weapons. Production must follow the trend in the use of weapons. Weapons of war are expendable. Development must go on in all fields. For in war, one never knows ahead of time what can happen through sudden changes in the over-all strategic situation. Thus we find ourselves putting aside defensive weapons and giving priority to offensive weapons. This is having a far-reaching effect on the aviation industry.

Early in our own war preparation there were two schools of aeronautical thought. One believed that we should freeze the designs of our aircraft in order to produce in quantity. The second believed that we should make no sacrifice to having the best, for it was considered very unhealthy to be in the air, facing an enemy, when you were sitting in the second best airplane. Fortunately, the latter school of thought prevailed. It gained great confidence when Britain won the Battle of Britain so bravely with a few aircraft of high quality, standing off a multitude of Germany's quantity-produced airplanes. True, that battle introduced Radar, which Britain had developed secretly to an extraordinary degree. Radar allowed Britain's few aircraft to be in the air where and when needed and not shot to pieces on the ground as was the case in Poland which had no knowledge of where and when the enemy would strike.

As we look backward it becomes clearer with every passing day of aerial warfare that the aircraft industry must dedicate itself to an ever-increasing effort in development. We can now see the strength of the Allied position. Britain, living close by her enemies, has been developing bombers capable of carrying enormous loads for medium distances and

(*Continued on page* 144)

FOR IDENTIFICATION



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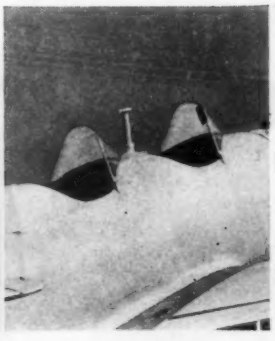

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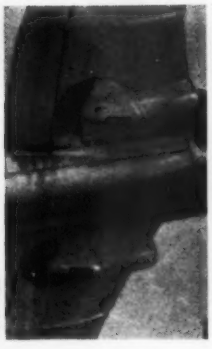

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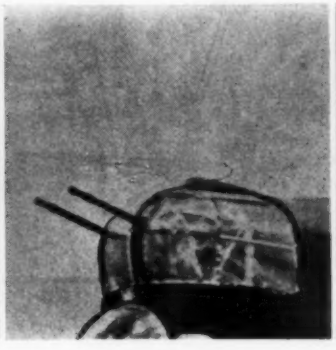

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The planes are: 1. Mitsubishi 00 (Jap Zero); 2. Grumman "Wildcat" (JAF-1); 3. Timm N2T1 Navy trainer; 4. Consolidated Vultee "Catalina"; Pby flying boat; 5. Consolidated "Liberator" (B-24); 6. Hawker "Typhoon"; 7. Vultee "Vengeance" dive bomber (A-31); 8. Avro "Lancaster" bomber; 9. Boeing "Flying Fortress (B-17E).

MISTAKEN IDENTITIES

Copyright, FLYING, September, 1943.

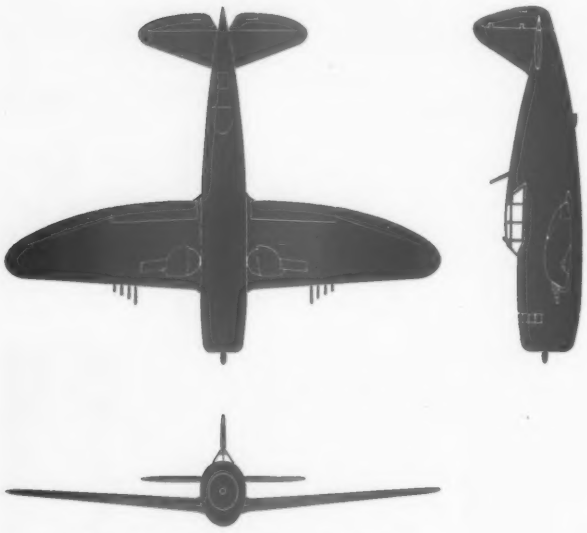
AN airplane frequently confused with a number of others is the Short *Stirling*, especially when seen from below. One American type with which it is confused is the Douglas *Skymaster*, widely-used cargo plane of the U. S. Army and Navy. When seen to exact scale as shown here, the differences are accentuated. Particularly notable is the huge fuselage of the *Skymaster*, and narrow wing.

Douglas "Skymaster"
Span: 117 ft. 6 in.

Short "Stirling"
Span: 99 feet.

REPUBLIC "THUNDERBOLT"

Fighter



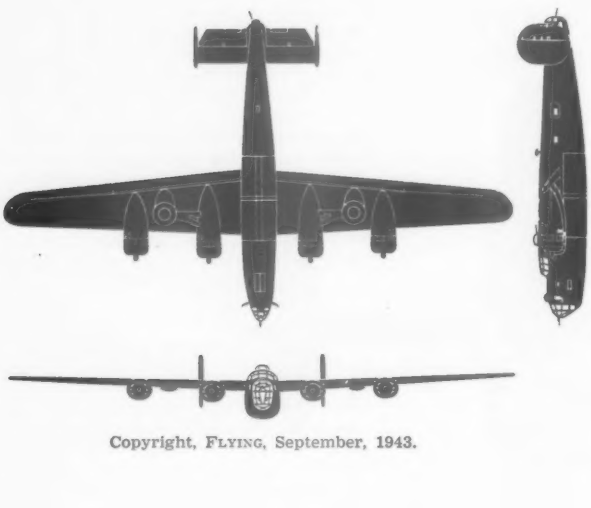
PERTINENT FACTS: The *Thunderbolt* P-47 is America's largest and most heavily armed, single-seat fighter plane. Its single 2,000 h.p., 18-cylinder two-row radial turbo-supercharged engine has given it speed at high altitudes believed equal to any fighter plane in the skys today. A big airplane, with a gross weight of 13,500 pounds, the *Thunderbolt* has a span of 40 ft., 9-5/16 in.; length of 35 ft., 5-3/16 in., and height of 12 ft., 4-11/16 in. It has a service ceiling of 40,000 feet and a maximum speed in excess of 400 m.p.h. It is armed with eight .50-caliber machine guns which are installed four in each wing staggered to give clearance for the breeches.

WHAT TO LOOK FOR: The *Thunderbolt* is a low-winged monoplane with dihedral of about 4°. The wings have a straight taper on the leading edge almost to the tips and an elliptical trailing edge. An unconventional feature is the oval shape of the cowling. The *Thunderbolt* is perhaps chiefly notable because of its large size, heavy-set lines and deep midsection with sloping back. The single rudder and fin is elliptical in shape.

Copyright, FLYING, September, 1943.

CONSOLIDATED "LIBERATOR"

Heavy Bomber



PERTINENT FACTS: The widely known *Liberator* is a high-altitude, heavy precision bomber in large production in the United States. Used by both Army (B-24) and Navy (PB4Y1), it has undergone considerable modification in armament since it first saw service. The *Liberator* is powered by four radial 1,200-h.p. turbo-supercharged air-cooled engines giving it a maximum speed of over 300 m.p.h. at optimum altitude, a cruising speed in excess of 200 m.p.h. and stalling speed of 79 m.p.h. Weighing 34,330 pounds empty and more than 50,000 pounds loaded, it has a range in excess of 4,000 miles and a service ceiling of 35,000 feet. It has a wing span of 110 feet, length of 66 ft., 4 in., and a height of 18 feet with nose wheel on the ground. The *Liberator* carries a bomb load up to 8,000 pounds and is armed with eight to 10 .50-caliber machine guns. It carries a crew of six to nine. A transport version called the *Liberator Express* can carry 20 men or haul freight. Chief structural changes are elimination of gun turrets and bomb bays and addition of windows along fuselage and cargo hatch near tail.

WHAT TO LOOK FOR: A high-wing monoplane, the *Liberator* has dihedral and a deep short fuselage with wing well back from transparent nose. The wings taper rather sharply on both edges. The four radial motors are housed behind oval cowlings. Noticeable feature is the huge twin fins and rudders at end of cantilever horizontal stabilizer. Main wheels retract outwards into the wings and nose wheel retracts forward into the fuselage.

Copyright, FLYING, September, 1943.

AIRPORT HAZARDS

Obstructions can be dealt with vigorously only when rigid rules and regulations are written into zoning law.

This tank at Detroit City Airport is an extreme example of hazards confronting planes landing at many ports.

by BLISS KELLY

UNDER rush orders and at the expense of millions of dollars Army and Naval airports have been completed in many parts of the nation, only to discover in numerous cases that an obstruction such as a farmer's windmill or some new building across the road, rendered the extreme end of a new runway useless. Or that a high-voltage power line has been strung over-night in the approach area close to the landing field.

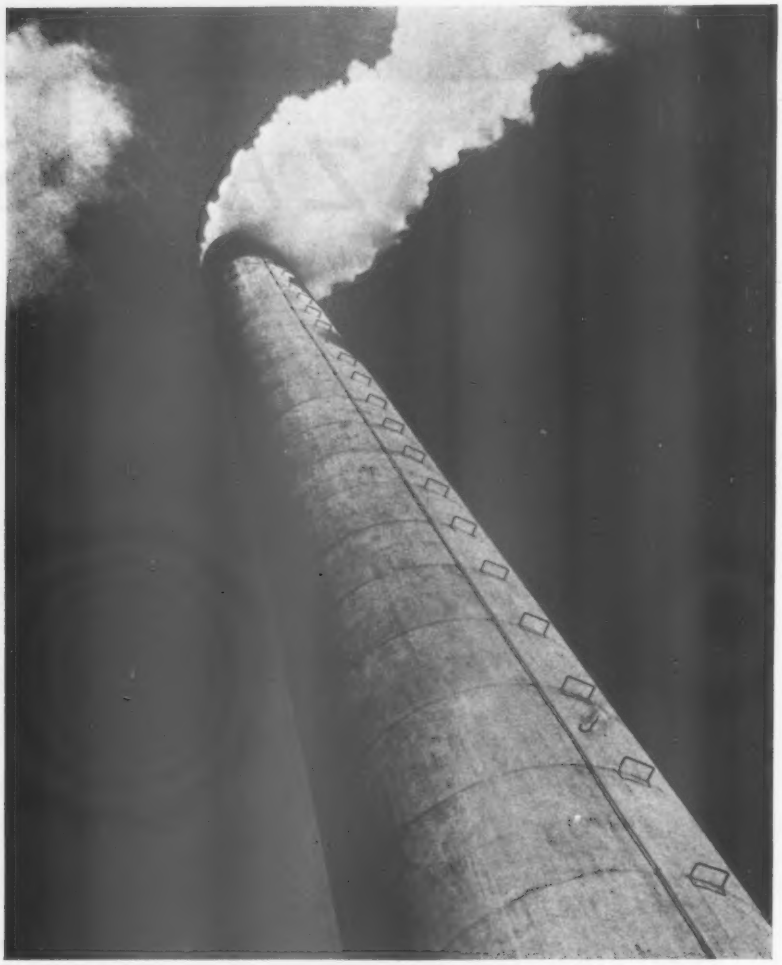
While some of this "airport sabotage" is merely the result of confusion and emergency conditions, there have been entirely too many instances reported where adjoining land owners deliberately have erected some flying hazard just off the end of a new mile-long runway, for the apparent purpose of forcing the purchase of the land and property involved at enormous prices. It is difficult to find many airports not affected in some way by hazardous obstructions.

Now a practicing attorney in Oklahoma City, Mr. Kelly has been a cowpuncher, printer, reporter. He has been interested in aviation for 20 years and has helped solve many airport planning problems in the mid-west.

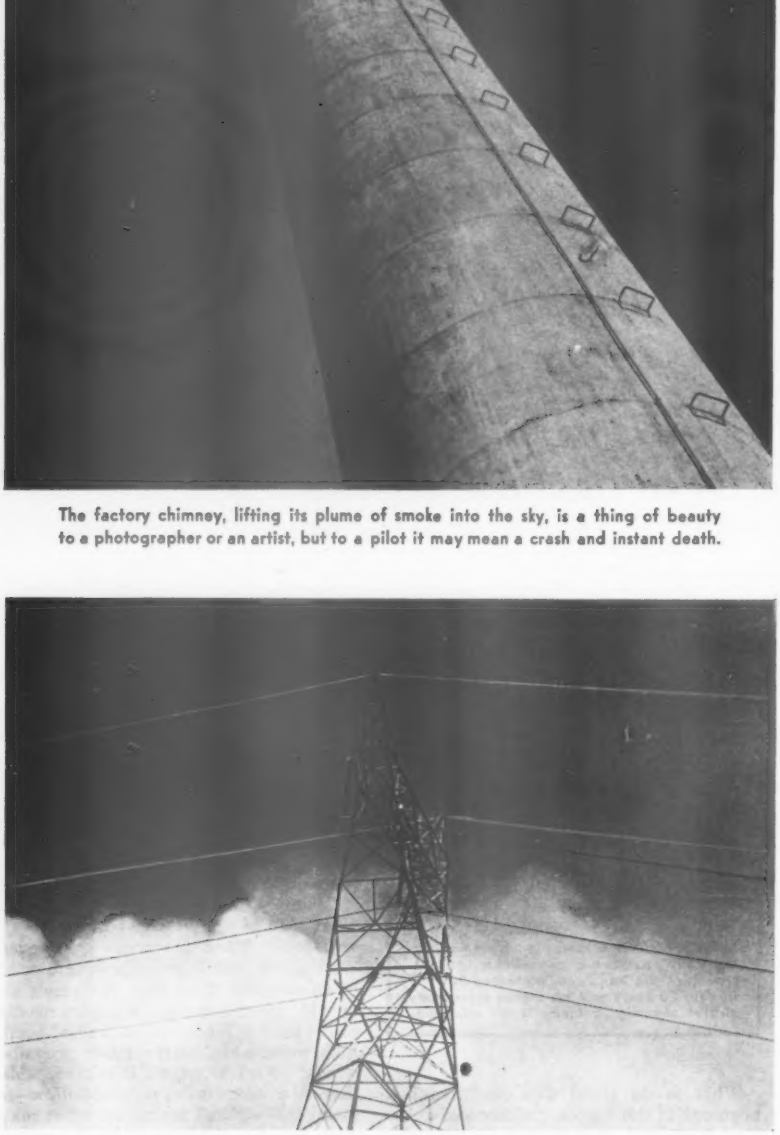
What to do about this condition has been one of the biggest problems of aviation during the last few years. Pay the price demanded by rapacious land owners? Or turn the port over to lightplane use exclusively and go farther out into the country to build a new port in the center of a tract large enough to provide safe landings for the huge planes of the present and the even larger ones of the future?

"There ought to be a law," airmen growl, "to control property around airports and prevent that kind of sabotage."

Certainly, there ought to be a law. But, what kind of a law? Did you ever try to write one? What clearances are needed? What is the safe angle of glide into or out of an airport? What kind of aircraft can, or will, use the particular airport needing protection? What about radio beams, hills, mountains, nearby cities, prevailing winds? And so on, ad infinitum. Also, there's a constitutional prohibition—remember?—against taking the other man's property without paying for it, even in war time. The property owner may be within his legal rights in erecting that



The factory chimney, lifting its plume of smoke into the sky, is a thing of beauty to a photographer or an artist, but to a pilot it may mean a crash and instant death.



Power lines are hard to see and a constant threat to low-flying aircraft. Satisfactory zoning laws would prevent the erection of such hazards near airports.

obstruction or hazard. (Although he may be perpetrating a form of "legal blackmail.")

"But," the flyers say, "we don't want to buy the whole county just to protect the approaches to an airport. All we want is reasonable limitations on the height of structures and adequate obstruction lights and beacons. We just want to get rid of that row of tall trees, that water or gas tower, that high-tension line, or that windmill."

That problem has been a headache for the Civil Aeronautics Administration, the Army Air Forces, the Navy, pilot training schools, commercial airlines and every allied branch of the aviation industry.

Almost every state has passed some sort of law in an effort to help, but none has yet been devised which will "get the job done." More than two years ago the CAA drew up a "Model State Airport Zoning Enabling Act," but the ink wasn't dry on the first draft before it had to be revised to meet legal objections as well as changing conditions.

This act met with little favor with the state legislatures. Even as it was being mailed out, the National Institute of Municipal Law Officers in Washington was putting the finishing touches on a different form of law, framed according to the ideas of these attorneys, attempting to accomplish the same purpose. Both proposed laws were necessarily long, involved and confusing, as well as indefinite as to terms; as a result few legislators took the trouble to try to even understand them.

Short, incomplete and inadequate laws were passed in most states. Most of these merely prohibited the erection or maintenance of any structure which might be a hazard to flying. Some affected an area of a half-mile around certain airports, while others covered as much as a six-mile radius. Some attempted to protect only airports owned by cities, disregarding military airports. Most of them are invalid for one reason or another, in most cases the invalidity being in attempting to confer power to make and enforce laws and regulations upon local officers or boards contrary to constitutional limitations, instead of including the basic rules and regulations within the law itself and then authorizing a local board or commission to administer and enforce the law.

First thing to decide, in framing any such law, is: What protection is needed? So far, no law yet passed or proposed has definitely answered that question. Yet, it is obvious that any such law, to be valid, must clearly fix some standard by which the local administering board shall be guided, as well as limited. It cannot merely prohibit "anything" which might be a "hazard to flying," and then turn a local board loose to do as it pleases, arbitrarily depriving a landowner of the lawful use of his property. The vice of such a law is self-evident.

Minimum standards of safe flying must be fixed, a hazard must be defined, the power and authority of local boards definitely set forth and safeguards provided for the rights of property owners as well as airports and flyers.

MINNESOTA ADOPTS AERONAUTICS CODE

Procedures for preventing future hazards in the vicinity of airports and eliminating those now present are provided for in the newly-adopted Minnesota Aeronautics Code.

A state aeronautics commissioner is empowered to adopt and to periodically revise airport approach plans, indicating hazards and what the height limits and other objectives should be.

Provision is made for acquiring the property on which hazardous uses exist by purchase, grant or condemnation according to regular legal procedures. Air rights or easements can also be acquired, or substitute properties or easements traded for those already acquired.

How can this be done, when each airport presents a different situation? Standards and rules which might work perfectly at one airport will be useless when applied to any other. Each airport's terrain is different, length of runways is different and kind of obstructions and hazards is different. This problem has been studied intensively for about three years by officials and experts of the various Governmental subdivisions and private aviation interests mentioned, taking into consideration present needs as well as possible requirements of the known future, have made the following recommendations for the basis of any airport protection or zoning law:

(1) "An airport protection area, covering all property within a radius of three miles from the outside boundaries of an airport, may be established.

(2) "An airport commission, consisting of representatives of the local government, military and commercial interests using or owning the airport, as well as representatives of the public, may be organized to put into effect and enforce regulations affecting the protection area, as well as operation of the airport.

(3) "Limitations upon the height of structures within the protection area may be imposed to any extent found necessary under the circumstances prevailing in each case (and these may be different for each runway or portion of the protection area), but such limitations may not be *more* restrictive than the following:

(a) "On all parts of the area within approaches to runways which are or may be used for instrument landings, on a ratio of one foot vertically to one hundred feet horizontal distance from the end of such runway for a distance of five thousand feet and thereafter to the outside boundary of such protection area fifty feet in height less than a ratio of one foot vertically to fifty feet horizontal distance from the end of such runway.

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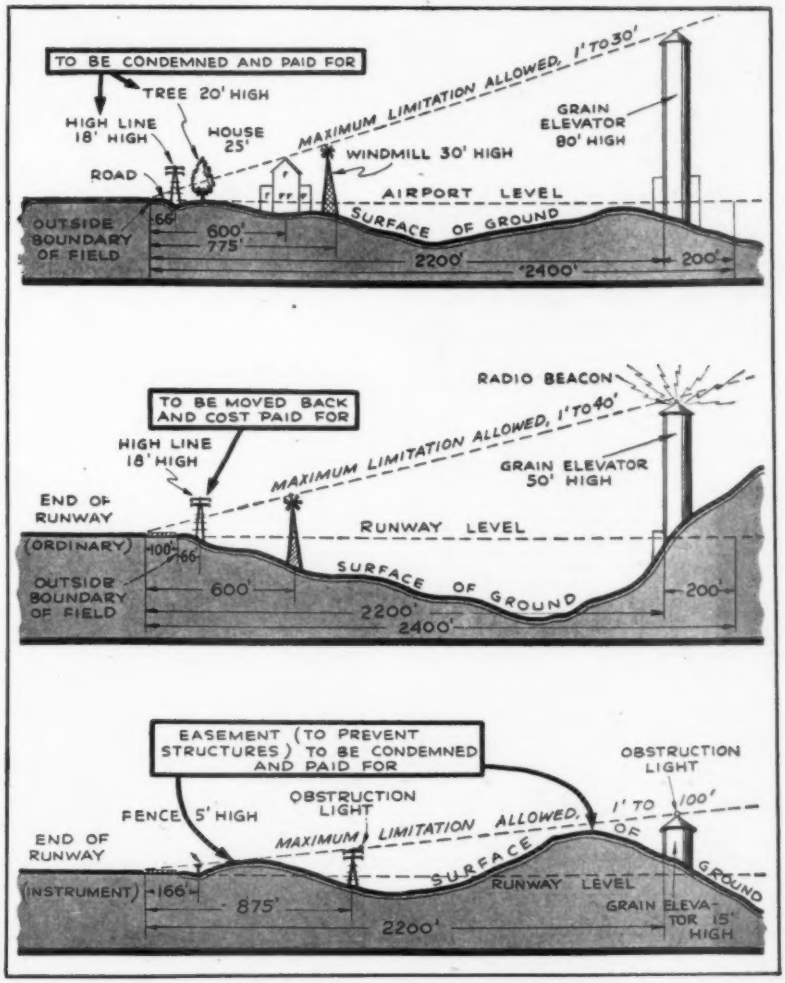
Water tanks are a common hazard. A model law defines structures as "anything above the surface of the ground," within a stated distance of airport runways.



Maximum restrictions suggested by author. Top diagram represents all areas not included within runway approaches; middle, areas within runway approaches; and lower, instrument approaches.

PLANES BLAZE TRAIL FOR ALASKA H

America's "Burma Road" could not have been completed in record time without the use of aircraft.

THE construction of the Alaska Highway, which extends from Fort St. John, B. C., to Fairbanks, Alaska, could not have been achieved in so short a time without the use of airplanes for reconnaissance, aerial photography and freighting of supplies and equipment.

For a number of years a road joining the United States and Alaska had been under discussion and during this time American and Canadian engineers had jointly investigated several routes. After Pearl Harbor, however, the imminent danger to the western coast and especially to Alaska made the rapid construction of this road an urgent military necessity.

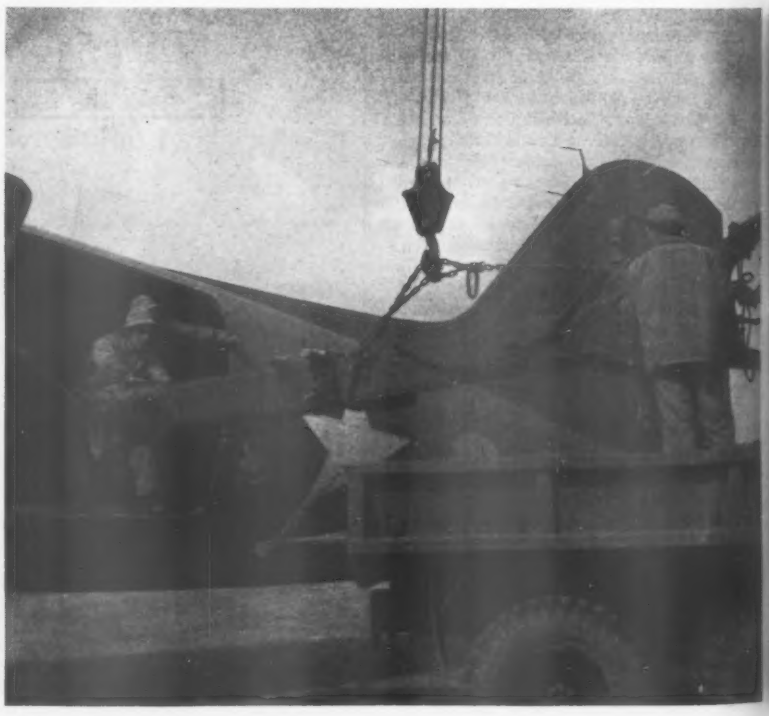
The location of airports decided the present location of the road. The Dominion of Canada had constructed airports at Grand Prairie, Fort St. John, Fort Nelson, Watson Lake and Whitehorse, and it was essential that the highway be constructed close enough to these ports to truck in fuel and equipment over short connecting roads.

The intention was that a tote or pilot road be constructed by the U. S. Army, to be used for access during construction of the final highway. The tote road necessarily would have to be constructed close to the final location.

The U. S. Public Roads Administration (PRA) was to organize and supervise the civilian contractors who were to build the final highway. Plans were revised later in the summer, however, and soldiers continued with road-building while all civilian labor was utilized for improving and surfacing the road so built. A good truck route was completed to Alaska before the end of the year.

The construction of the tote road was divided into two sectors for the Army

Planes were used to haul the heaviest equipment between isolated access points on the Alaska Highway. Here a road grader part is being loaded on a Douglas Army transport.



HIGHWAY...

The author is location engineer of the Ontario Department of Highways. Because of his wide experience with aerial photography he was called in to assist U. S. Engineers in locating the Alaska Highway.

by K. H. SIDDALL

engineers, a northern sector extending from Lower Post to Fairbanks via Whitehorse and a southern sector from Fort St. John to Lower Post via Fort Nelson. Each of these sectors comprised half the total length of the road to be built. The sectors were divided into separate working units.

Large scale maps of the country were available, but numerous inaccuracies were found. Large rivers were sometimes in the wrong position and frequently were omitted entirely. Very little was indicated of the terrain features such as mountains, lakes, rivers, swamps, drainage and muskeg which are so necessary to determine a desirable route.

Especially is this true in the case of muskegs (prehistoric lakes and rivers that have filled with glacial muck and an overburden of decomposed vegetable matter). The muskegs are boggy areas, usually covered with a thick growth of small spruce or tamarack trees and vary from a few to many feet in depth. If at all possible, they are avoided when locating a road.

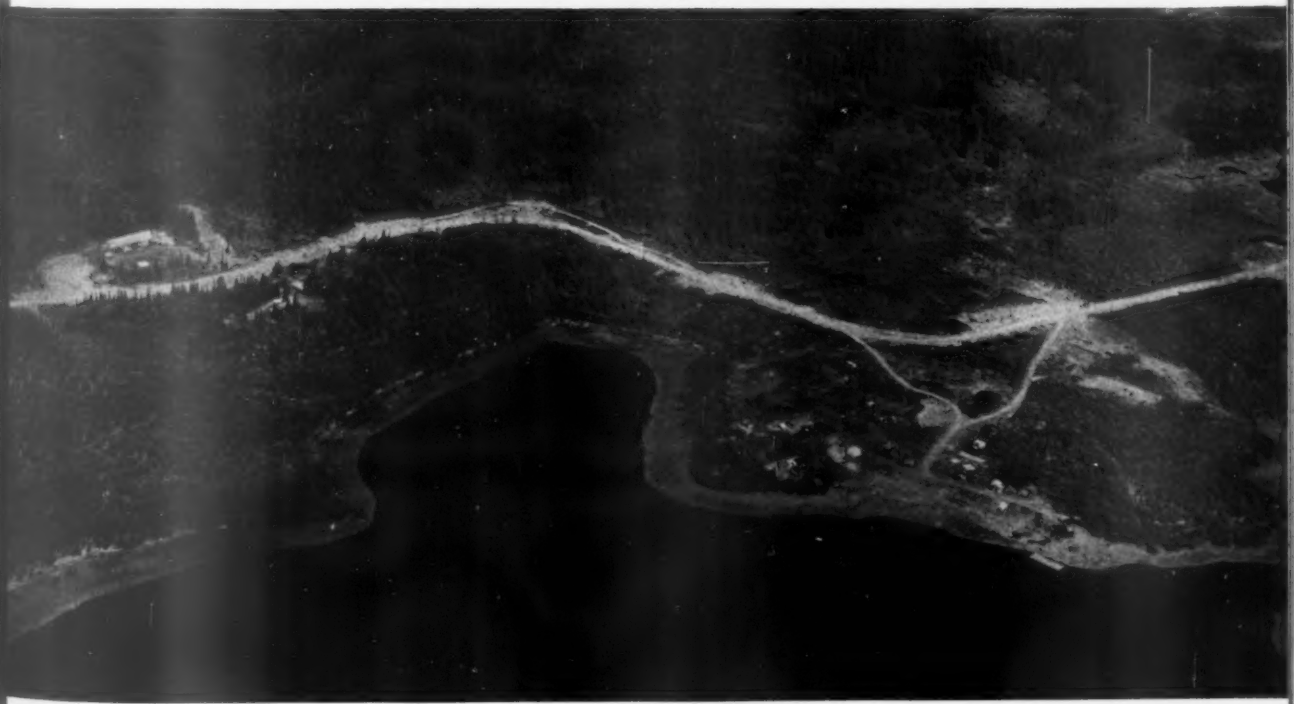
The PRA started seven separate location parties working north from Fort St. John. These parties were considered as one unit and there were four such units on the project. It was estimated that each party would locate half a mile of final line a day. The Army was to offset sufficiently from this final highway line for the construction of the so-called tote road.

This arrangement would have worked perfectly had the location parties been able to complete their estimated number of miles each day. A regiment of 1,500 men was placed on the construction of this section of the road with sufficient equipment to build an average of two and one-half miles per day. However, after 21 days' work only 17 miles, instead of the scheduled 52 miles of road, were completed. This slow rate of progress was due to the inexperience of the soldiers operating the equipment and the fact that they were held up for the location.

The first difficulty was being overcome daily and it became evident that the progress of the whole job was being impeded by the slow rate of locating the road. The commanding officer, Col. James A. O'Connor (now brigadier general) was demanding more miles of completed road and the soldiers under his command were quite capable of doing the job.

The PRA location engineers were in

The Army pushed the highway over naked granite hills and through virgin timber. Note two side roads leading from the main route to an old Indian village on the edge of a lake, giving it more direct access to the outside world.



difficulty. They were using the old orthodox method of locating by foot reconnaissance, aided by numerous aerial observation flights over the area.

It is very disconcerting to an engineer, believing that he has a good line, to find that he is running into some impossible ground feature requiring the abandonment of several days' work. The demand for speed in the road construction made it mandatory to select a route with a minimum number of river, stream and swamp crossings and with as little grading of earth and rock as possible.

In this section of the country the frost remains in the ground all year on steep northern slopes, particularly where heavily wooded areas prevent the sun's rays from penetrating. Prevailing winds are from the south and the sun's best drying effect is also from that direction. Hence, wherever possible the road would be located on the top or south slope of all ridges. With these requirements in mind it was still necessary to locate as many as eight to 10 miles of line per day through tracts of wilderness.

Thus it was soon realized that normal road location procedure by means of ground reconnaissance and elaborate survey and staking parties would take too long and that other methods must be used.

The location information gathered from trappers, guides and Indians proved to be practically useless. Advice from such sources showed a surprisingly limited knowledge of the areas and could be very misleading. Following it almost caused a serious accident later on when it was decided to locate the highway by aerial reconnaissance.

At the time that the road along the Liard River was under discussion, the Indian guides were firmly convinced that their trail should be followed. It was a more circuitous route through the mountains, but the Indians said "Indian way take one summer, white man way, two summers." It was decided to investigate the route and a party of men with pack horses started up the trail. They were not heard from by the time the construction of the road had reached the point where it had to either turn up the trail or continue down to the Liard River.

Orders were given to look the route over from the air. When we arrived at the beginning of the trail we were flying at approximately 2,500 feet above the ground and had turned up the pass which the trail was following. We proceeded about five miles when the pass began to narrow to a river bed only and it became obvious that the pass was rising faster than the plane could climb.

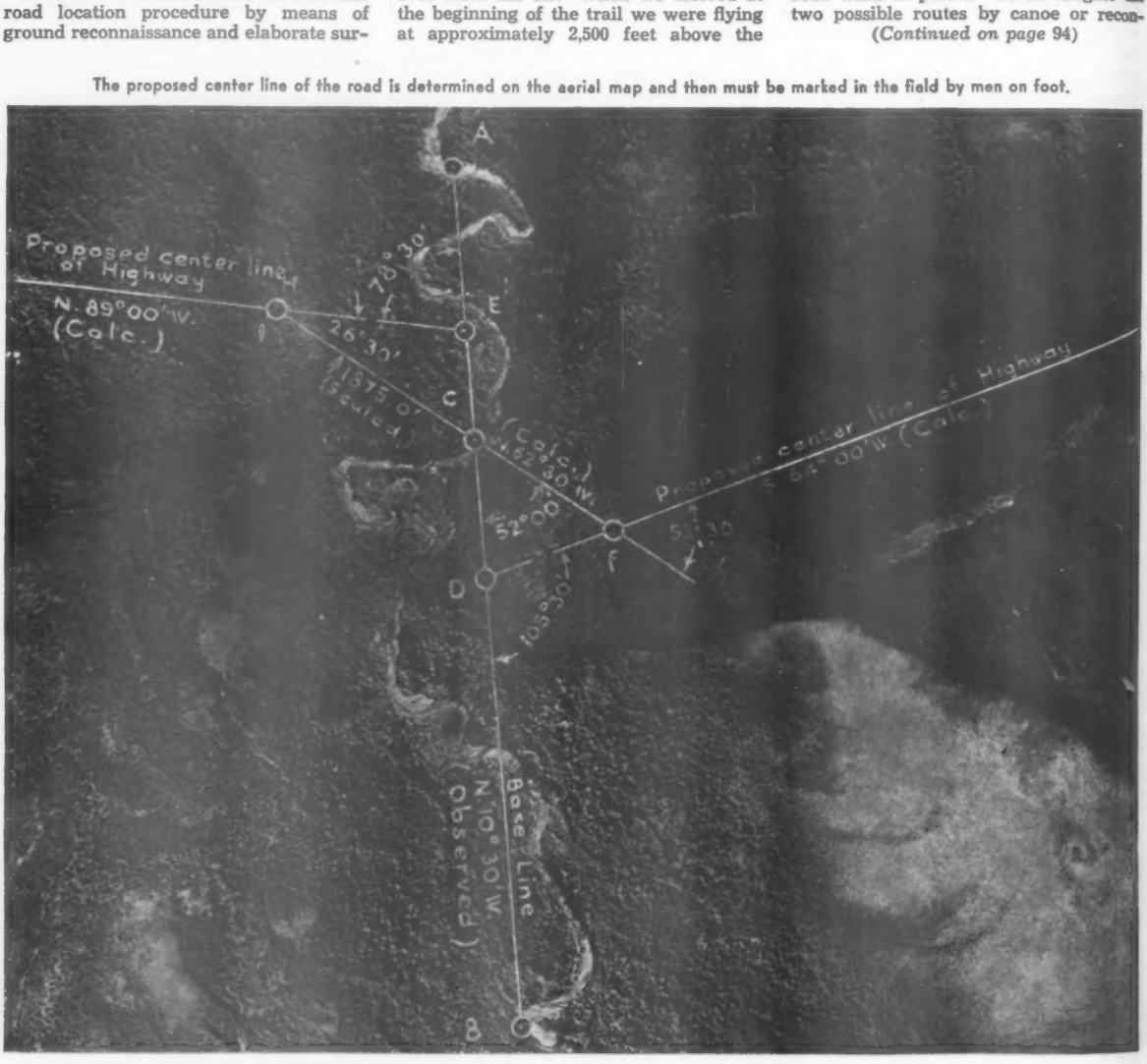
The situation was grave; the pass was too narrow to permit a complete turn and the plane could not gain sufficient height to pass over the summit. We were saved when an isolated mountain appeared on the left permitting us to swing and circle it in order to gain altitude.

Perhaps this experience taught us a lesson, for we were becoming somewhat careless by flying too low over country which we had never seen in order to get a good view of the ground conditions. The trail was not used and the white man's way, which was to have taken two summers, was completed in one month.

There were two schools of thought as to which side of the Liard River the road should traverse from the mouth of the Trout to Lower Post. The Liard is quite a large river, 1,000 feet wide and narrowing to 200-foot gorges with precipitous rock walls in places. To investigate the two possible routes by canoe or recon-

(*Continued on page 94*)

The proposed center line of the road is determined on the aerial map and then must be marked in the field by men on foot.



LONDON SURVEY

by PETER G. MASEFIELD

Technical Editor, "The Aeroplane," London, England

Authentic statistics prove that Germany's war effort can be decisively hurt by aerial bombing.

WE HAVE heard much of the destruction caused by the steadily mounting weight of attack from the air by the bombing forces of the United Nations—of hundreds of acres devastated in German cities, of essential war factories blasted out of production and of the coming air assault on Japan. Yet so far there has been no yardstick by which to assess more precisely the results achieved and achievable in comparison with the enemy's war effort as a whole and with the effort put into the offensive by the Allies. In the absence of even approximate figures of this nature many antagonists of bombing remain unconvinced of its value and continue to decry its effect. At the same time many advocates of the power of the strategic bombing force have few concrete facts on which to found their arguments.

Sufficient experience has now been gained with night bombing against industrial targets in Germany to assess results in terms of the destruction of enemy war effort. In fact, during the month of May (the last for which complete figures could be estimated at the time of writing), British and American heavy bombers reduced the German industrial war effort by at least 24 per cent in dropping some 15,000 British tons (16,700 U.S. tons) of bombs. In other words about four times the effort expended in bombing during the month of May would bid fair to shatter the German war machine completely.

American day bombing and British night bombing dovetail together in the most complete fashion to form the overall pattern of results—each aiding the other to gain the maximum effect. The two cannot be strictly compared because, whereas the RAF has concentrated its technique on area bombing at night with bombers specially designed to carry heavy loads at a sacrifice in defensive armament, the United States Army Air Forces has specialized in the complementary daylight precision bombing from heavily defended bombers capable of fighting their way to and from the targets. This article is thus a study of the effect of British night bombing and is an attempt to analyze the results and present them in a logical form. Another, and different, method must be followed in assessing the results of the American day bombing which is such an important and steadily increasing contribution to the overall air assault on the Reich.

The truth is that both day and night bombing are essential and complementary to each other, for only by combined means can the enemy's defenses be stretched to the uttermost and the full results achieved. Night bombing is most effective against large industrial areas, day bombing against concentrated factory targets. And each contributes in its own way towards the smashing of the whole Nazi structure, like the combination of the sledge hammer and the cold chisel in razing a house.

The effect of bombing can be divided into two main aspects:

(1) Loss of factory output to the enemy.

(2) Extra work caused to the enemy in repairs, replacements, etc.

In reckoning this, the only true criterion is the number of man-hours of work taken from direct war production in enemy territory. A nation's assets in war are solely man-hours; money ceases to count —except internally. Every nation has just so many man-hours of capital to expend each month. The more that can be squandered by the attacker the poorer that nation's war effort will become.

The calculations show in round figures the following results, based on present experience:

MAN HOURS NEUTRALIZED PER TON (2,240 POUNDS) OF BOMBS DROPPED AT NIGHT.

(1) Loss of work to enemy = 4,000 man-hours

(2) Extra work caused to enemy = 4,000 man-hours.

TOTAL DESTRUCTION PER TON = 8,000 man-hours

In precise terms, a 2,000-ton night raid on Germany by 800 British bombers causes damage, on an average, equivalent to the whole work of at least 77,000 Germans for one month and costs the work of 18,500 Allied men and women for the same period to achieve it. That was the approximate scale of night attack during May, 1943.

Each *Lancaster* in an operating life of 20 night sorties, deprives the enemy of the work of 960 men for two months. The *Lancaster* shows a net gain over effort represented by the work of 730 of the enemy for two months.

These figures do not take into account the influence on enemy morale of continuous air attack. This effect is now becoming very great indeed and causes a serious drop in production in addition to the direct results. Nevertheless for cold mathematical analysis the moral effect may be ignored—though not forgotten. Direct damage can compel the enemy to stop fighting. Lack of morale can only make that fighting less effective when the final test on land arrives.

So much for general conclusions. The

(*Continued on page* 84)

BASIC FIGURES

NIGHT BOMBING DESTRUCTION	COST PER NIGHT-BOMBER SORTIE (At 5 per cent. loss)
BOMB LOAD PER SORTIE = 2½ tons (5,600 lb.)	BOMBS (2½ tons) = 100 man hours
DEVASTATED AREA PER SORTIE = 0.5 acres	FUEL (900 gals.) = 150 man hours
MAN POWER AFFECTED PER SORTIE = 15 men	CREW (1/20 of 8 men) = 800 man hours
LOSS OF WORK PER SORTIE = 10,000 man hours	BOMBER (1/20 of 70,000 man hours) = 3,500 man hours
EXTRA WORK PER SORTIE = 10,000 man hours	SERVICING, etc. = 450 man hours
IMPEDIMENT TO ENEMY PER SORTIE = 20,000 man hours = 8,000 man hours per ton of bomb load	TOTAL COST PER SORTIE = 5,000 man hours = 2,000 man hours per ton of bomb load
DESTRUCTION BY 2,000 TON (800 bomber) RAID = 16,000,000 man hours to enemy	COST OF 2,000 TON (800 bomber) RAID = 4,000,000 man hours to Allies

DAY BOMBING DESTRUCTION	COST PER DAY-BOMBER SORTIE (At 4 per cent. loss)
BOMB LOAD PER SORTIE = 1.5 tons (3,350 lb.)	BOMBS (U. S.) (1.5 tons) = 100 man hours
DEVASTATED AREA PER SORTIE = 0.18 acres	FUEL (900 gals.) = 150 man hours
MAN POWER AFFECTED PER SORTIE = 12 men	CREW (1/25 of 10 men) = 800 man hours
LOSS OF WORK PER SORTIE = 6,500 man hours	BOMBER (1/25 of 75,000 man hours) = 3,000 man hours
EXTRA WORK PER SORTIE = 4,500 man hours	SERVICING, etc. = 450 man hours
TOTAL IMPEDIMENT TO ENEMY PER SORTIE = 11,000 man hours = 7,340 man hours per ton of bomb load	TOTAL COST PER SORTIE = 4,500 man hours = 3,000 man hours per ton of bomb load
DESTRUCTION BY 450 TON (300 bomber) RAID = 3,300,000 man hours	COST = 1,350,000 man hours to Allies

WAR AND THE CAA

by H. F. ILLICH

Chief of the Airmen's Section of the General Inspection Division of CAA, H. F. Illich, at 40, has logged some 5,900 hours in the past 18 years. Once a skywriter, Illich made a typographical error 3,000 feet high when he left the "H" out of "Show" in advertising an aircraft show in New York City.

With half of the inspectors in the armed services, those left are burdened with added duties.

WAR brought the CAA aeronautical inspector an increased burden of work and then added to his difficulties by cutting his numbers in half.

This situation is typical with most of the staff of the CAA. But in the field, with the Aeronautical Inspectors, the men who meet the flying public—who cover itineraries that sometimes sound like Churchill's—it is particularly true. They lead full lives which include days when they are on the go from daylight till after dark traveling from airport to airport, and then after the day's field work is done, toil in office or hotel room, writing the inevitable reports on what they have done. Always facing them is a piled-up mass of detail work still to be done.

There are times, according to one of them, when he lands at a field and observes the large group of assorted applicants for pilot and mechanic certificates lined up waiting for him, that he "just gets discouraged and feels ready to go back to the farm." Fortunately he doesn't, because the CAA inspector is aviation personified to the thousands who are just coming into the flying game. Without him, all would be chaos; accident figures would spiral upward and flying might actually become the hazard old-fashioned people think it is.

This is not to say that the regulations laid down by the CAA and the Civil Aeronautics Board (and enforced by the aeronautical inspectors) are the only reasons flying is safe, nor even the principal reasons for safe flying. It does mean, however, that the fast, efficient system by which the CAA is able to certify to the ability of pilots and mechanics, the adequacy of the repair job done on a plane after an accident, the competency of a flying school to teach, the examination of a physically handicapped pilot to determine his fitness to fly, and a full dozen other important routine duties of the inspector is still working despite the handicaps which war has thrown around it.

There may have been a decrease in the efficiency of this system and CAA officials would be the first to admit it, blaming the very large percentage of inspectors now in the armed services. Most of them, highly skilled and long experienced in aviation, are extremely valuable men to the military and many have been called to the colors. About a year ago, 95 men were taken from the Safety Regulation Service alone, and put into active service. And the replacement of experienced men these days is no simple matter, especially in this flying global war. The result has been longer lines of waiting students at airports, with regrettable delays in many cases, in spite of many short cuts which have been adopted by the CAA.

Before the war, the custom was for an aeronautical inspector and an aircraft inspector to make their rounds together and divide the work awaiting them at each field. They operated out of the regional and district offices of the CAA, scattered about the country at some 60 points so as to decentralize the regulatory and inspection services of the agency and provide easier access by the aviation industry. Now, however, scarcity of qualified men requires that inspectors travel alone in most instances.

A few of the inspector's routine duties have slacked off a bit since the war began. These are more than offset, however, by the new jobs required by the military services and the difficulties a wartime flying program has imposed. The War Training Service also has added a heavy load. Not every pilot trained now for the Army or Navy by the flight operators who contract with the CAA has to go through general inspection and get his certificate, but most of them want to get licenses even if they are headed directly for military schools to become combat pilots. It is not unusual for an inspector to land at a field and find 12 to 30 pilots ready for examination. Such a volume of work to be done in one or two visits a week at a field and continued week after week, is not a heartening prospect for any inspector, but it establishes these men as important cogs in the war effort.

The old-time peddler who carried all

(*Continued on page* 130)

The trained eyes of the CAA inspector are the public's assurance that flying equipment is properly serviced and in safe operating condition when it leaves the shop.

CIVIL AIRCRAFT, IN OFFICIAL CAA COLORS, ARE USED BY CAA INSPECTORS IN THEIR WORK

"LIBERATOR EXPRESS" CARRIES 5 TONS OF CARGO ON 1000-MILE FLIGHTS

Your
the s
—of
city
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Stalingrad Story

Your children's children will thrill to the story of Stalingrad.

—of the besieged, battered, hopeless city that was saved by white hooded infantrymen crawling on their bellies in swirling wastes of snow.

—saved by heroic ground forces whose magnificent air support never failed them.

Bell Airacobras, roaring over the Stalingrad front, gave wings to artillery. Above the masses of men and tanks locked in combat on the ground, they hunted out the enemy's vital spots—blasted them at short range with explosive and armor piercing cannon shells. Providing air support for ground troops is a job the Airacobra does superlatively well.

Here's the significant point. Airacobras were there in force when they were needed. We're able to deliver planes for action now *when they're needed* in this global war, because we started early enough, planned well enough and pushed production hard enough.

After victory we'll be telling you about new Bell planes, planes of peace. What will they be like? Well, they'll be designed, engineered and built by an organization that makes a habit of aviation pioneering. © Bell Aircraft Corporation, Buffalo and Niagara Falls, New York.

Airacobras for victory—

FUTURE PLANES FOR PEACE

BELL *Aircraft*

PACEMAKER OF AVIATION PROGRESS

AIR EVACUATION NURSES LEARN HOW TO PITCH TENTS

HISTORY'S *Greatest* MASS FLIGHT

Not until the war is over and the need for secrecy is ended can the full importance of this achievement be realized. All that can be told today is that a large number of giant Curtiss Commando Transports in mass flight have spanned 15,000 miles of ocean and the land of three continents to complete the longest mass flight in history.

From an unrevealed starting point in the continental United States, they delivered without incident, *ninety tons* of cargo and a large group of military personnel in the time of *four and one half days.*

We salute the pilots, the crew and the ground organization of the Army Air Forces and Air Transport Command whose excellent performance made this flight possible. We, of Curtiss-Wright, know that this is but the beginning of a history making epic which will again prove the dependability, serviceability and cargo capacity of the Curtiss Commando.

CURTISS-WRIGHT
Corporation
AIRPLANE DIVISION

Member: Aircraft War Production Council, East Coast, Inc.

FIRST
Since the Birth of Aviation

CURTISS *Commandos*

FOR CARGO AND COMMERCE

INTERPRETING AERIAL PHOTOGRAPHS WITH THE FAIRCHILD MAGNIFYING STEREOSCOPE

DIAGNOSTICIANS OF DESIGN

...are working together to make good planes better

One of the most significant aspects of the contributions of the aircraft industry to our country's war effort, has been the exchange and utilization of specialized abilities on a cooperative, intra-industry basis.

At McDonnell, we have been privileged to work with the Army and Navy, and with a number of aircraft manufacturers on assignments involving specialized research.

Detailed information concerning the results achieved by our engineers, is of military necessity, restricted. We can, however, mention a few among many projects brought to successful completion.

Among these were: an *aerodynamic research* assignment on a well-known combat plane which has seen action in many engagements; a *flutter research* assignment on a giant plane being built by one of America's largest aircraft manufacturers; the *development* of strong, lightweight *plastic ammunition boxes;* and the *redesigning* of *gun turret parts* to permit the use of weight-saving plastic.

We are prepared to carry out further research assignments—with particular reference to *flutter research,* and the *development* and *use* of *plastics* in many phases of aircraft design and manufacture. We shall welcome inquiries.

McDONNELL *Aircraft Corporation*

Manufacturers of PLANES · PARTS · PLASTICS ★ SAINT LOUIS - MEMPHIS ★

204

Sugar and spice... and everything nice...

THAT'S WHAT BOMBERS ARE MADE OF

The sweets your little girl won't eat as often as she used to.

Your extra cup of coffee.

Those Sunday drives with the kids.

The evening picnic by a quiet lake after hot days in town.

That new car you're not going to get and tires you won't have to drive on.

12,000 telephone calls.

300,000 rivets.

Aluminum and steel from your washing machine and other civilized appliances.

. . . add bombs, ammunition, guns, trained crews . . . communication systems and safety devices.

AND THAT'S WHAT BOMBERS ARE MADE OF.

Note, if you please, our contribution to these great planes with which go our hopes for peace and justice... for we manufacture radio communications equipment that directs the invisible pathways under stars or through blackest night... also hydraulic systems that actuate bomb bay doors, and gun turrets... these and other hydraulic items such as the important ones which simplify landings of victorious but tired pilots, are but a few of the many units of precision equipment we supply to builders of fine aircraft.

Joseph E. Walker
PRESIDENT

AIRCRAFT ACCESSORIES CORPORATION

MANUFACTURERS OF

AAC Products

PRECISION AIRCRAFT EQUIPMENT
HYDRAULICS . . . ELECTRONICS

BURBANK, CALIF. • KANSAS CITY, KANS. • NEW YORK, N. Y.
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THAT'S WHAT BOMBERS ARE MADE OF

The sweets your little girl won't eat as often as she used to.

Your extra cup of coffee.

Those Sunday drives with the kids.

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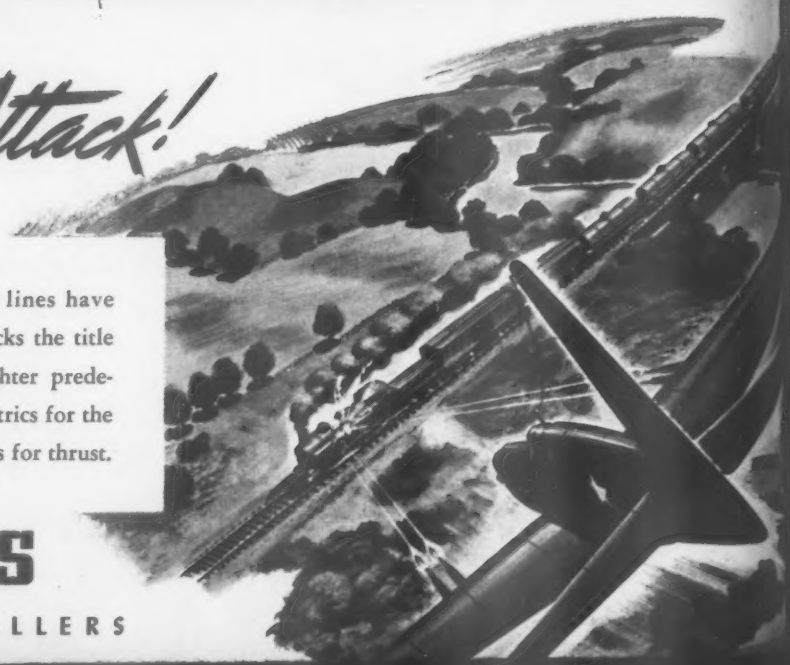
HYDRAULICS . . . ELECTRONICS

BURBANK, CALIF. • KANSAS CITY, KANS. • NEW YORK, N. Y.
CABLE ADDRESS: RACFRO

Mustang Attack!

Devastating raids on enemy rail lines have earned North American A-36 Attacks the title of "Train Busters." Like their fighter predecessors, they depend on Curtiss Electrics for the instant response to variable demands for thrust.



CURTISS

ELECTRIC PROPELLERS

HAVE YOU SEEN?

Precision bombing by "Flying Fortresses" of the Northwest African Air Force is strikingly demonstrated here in a successful attack on an oil refinery in Leghorn, Italy. Above, bombs are starting downward toward refinery, shown in center of the picture. Below, they have landed squarely on their target which is shown exploding in smoke and flame.

White rectangles and red border enclosing entire unit give new AAF insignia 60 per cent greater visibility.

Not an oversize plane tire but a barrage balloon of the type recently placed in strategic positions to protect New York City.

I Learned About Flying From That!—No. 49

by DAVID C. COOKE

A church steeple pushing up through the fog guided this two-hour pilot to a safe landing.

I KNEW all there was to know about flying and aviation—so I thought. According to my log book I had something less than two hours solo on *Cubs* under my belt. But of course it would have been more if my instructor, Vic Marks, had let me go when I "knew" he should have.

Regardless of my "long" experience Vic still tried to keep me under his wing and on that 1937 Sunday morning he cautioned me to stay near Roosevelt Field because one of those typical Long Island pea-soup fogs was slowly rolling in from the east. But I had different ideas; I wanted to fly out to the Seversky field at Farmingdale, L. I., and shoot landings. It was only a few miles and a very few minutes by *Cub* so I didn't believe I would have any difficulty.

Once in the air it was a different problem. Although the fog was moving along ever so slowly down below there was plenty of cross-wind upstairs and I battled and bucked all the way to Farmingdale, following a wide highway.

And then it suddenly got worse. The little drifting wisps of fog that I had encountered around Roosevelt were a lot different here. The fog was almost a solid mass with small holes appearing occasionally. Still I wasn't worried. I knew the Seversky field and the surrounding territory well because of formerly having flown from there. With this wind, I figured, I could come in smoothly over a cement pipe plant, the location of which I had firmly fixed in my mind, and touch easily about the middle of the field, rolling all the way to the hangar at the far end if necessary. The field was plenty large and with a *Cub* it should be a cinch.

At 26, David Cooke has been an experimental mechanic at Seversky Aircraft, a shop worker for Ranger Aircraft Engines, a draftsman for Grumman and author or editor of four books. But for luck, his career might easily have ended with the incident recounted here.

The approach worked out exactly as I had planned. When I eventually saw the dye plant on the left and the cement pipe plant on the right I knew I was almost on the field. I cut the throttle as far as possible, just giving enough so that I would not be blown back to Roosevelt Field by the ever-increasing wind, and started to ease forward on the stick to approach over the wires. It wasn't quite so bad close to the ground and the Cub settled as smoothly as could be expected. I yanked the stick back to my stomach and held.

All three points touched in reasonable proximity when the ship came to a sudden halt. There had been plenty of rain the past few days and I had been unfortunate enough to hit a bare spot on the field's otherwise smooth grass surface. The wheels were stuck fast in hub-high mud!

I had enough presence of mind to cut the switch as the tail started to point skyward and I tried to haul back even farther on the stick. Luckily, though, the Cub didn't go up on its nose, probably because of the stiff wind and not because of my efforts, and the tail settled back with a jarring crash.

After a cursory examination of the ship I discovered that there was no apparent damage and started the engine. But it was impossible to blast the *Cub* from the mud and I had to get out and prop the tail up on my shoulder in the approved manner and lug and pull and twist to get the wheels free and on solid ground.

I've often wondered why I didn't just stay there until the fog blew over. I lived in Farmingdale and could easily have got help to anchor the plane down. But at the moment I didn't realize the possible danger of the return trip and I took off even though visibility couldn't have been more than 100 yards at the outside. After leaving Farmingdale, however, visibility was much worse and the highway I was following disappeared completely.

After a reasonable length of time I thought that I should be near Roosevelt and started to look. But there were no holes in the fog and even the huge water tower at Mitchel Field was completely hidden. Then, for the first time, worry dew began to gather on my forehead. I started to come down through, hoping to find the field by beginner's dumb luck, but the thought of trying to push that checkered water tower out of the way was none too inviting. There was also the menace of trees near the edge of the field—and the high-tension wires didn't make me feel any better.

So instead of trying to make it blind I cruised around, praying that some kind divinity would blow a hole through the soup and let this inexperienced one at least see a hangar below. But the fog seemed to close up even tighter, holding the ground below in a death shroud.

The gas tank had been full when I left Roosevelt and the bob up front was slowly lowering. I just had to do something—and quickly—when I dimly saw a toothpick in the ocean.

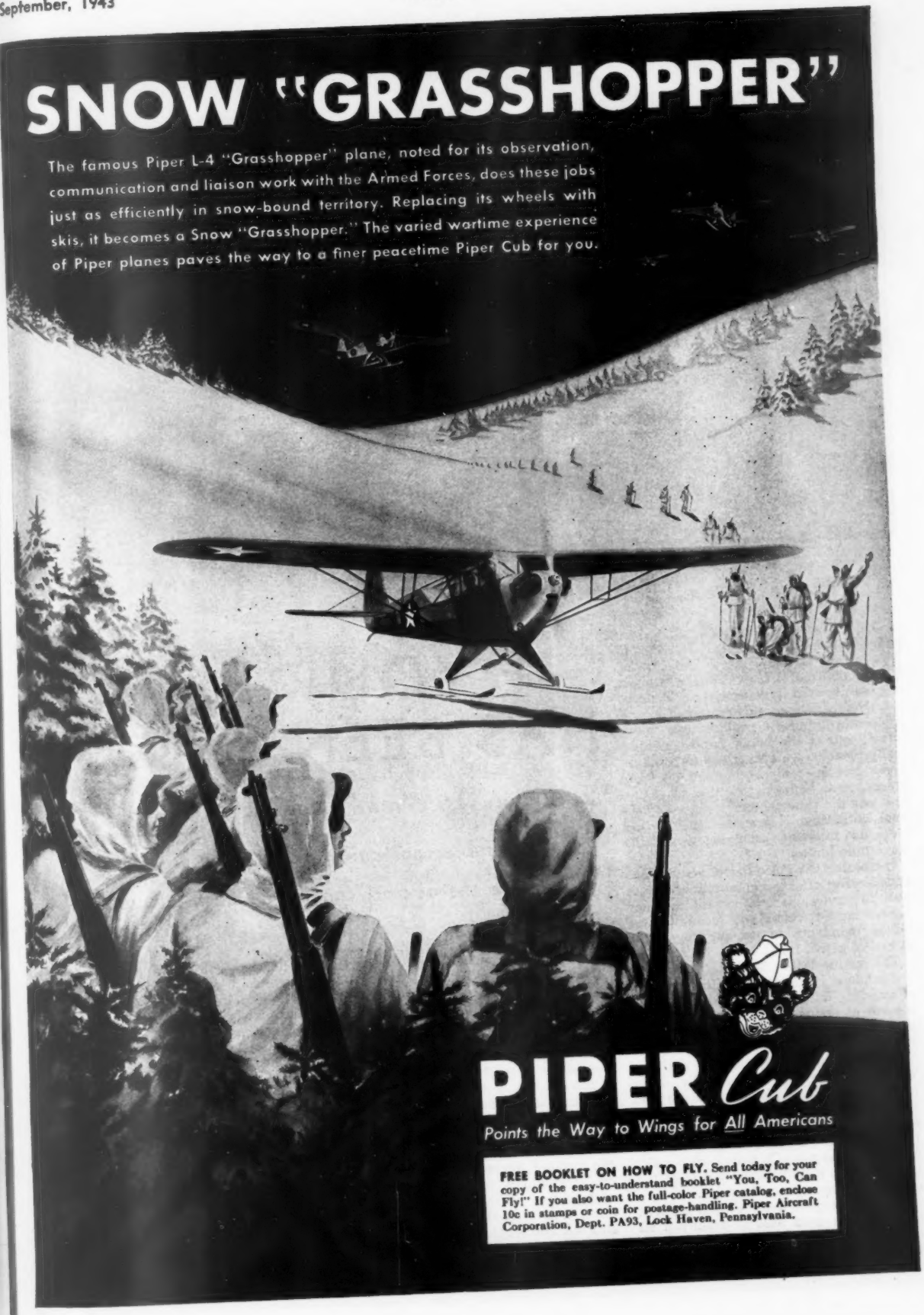
That "toothpick" was the steeple of a Garden City church jutting its proud neck up through the fog. It was the only structure in the area large enough to push through the overcast . . .

(*Continued on page* 128)

Happy enough here, the author felt quite different when he was cruising through fog seeking his home field.

SNOW "GRASSHOPPER"

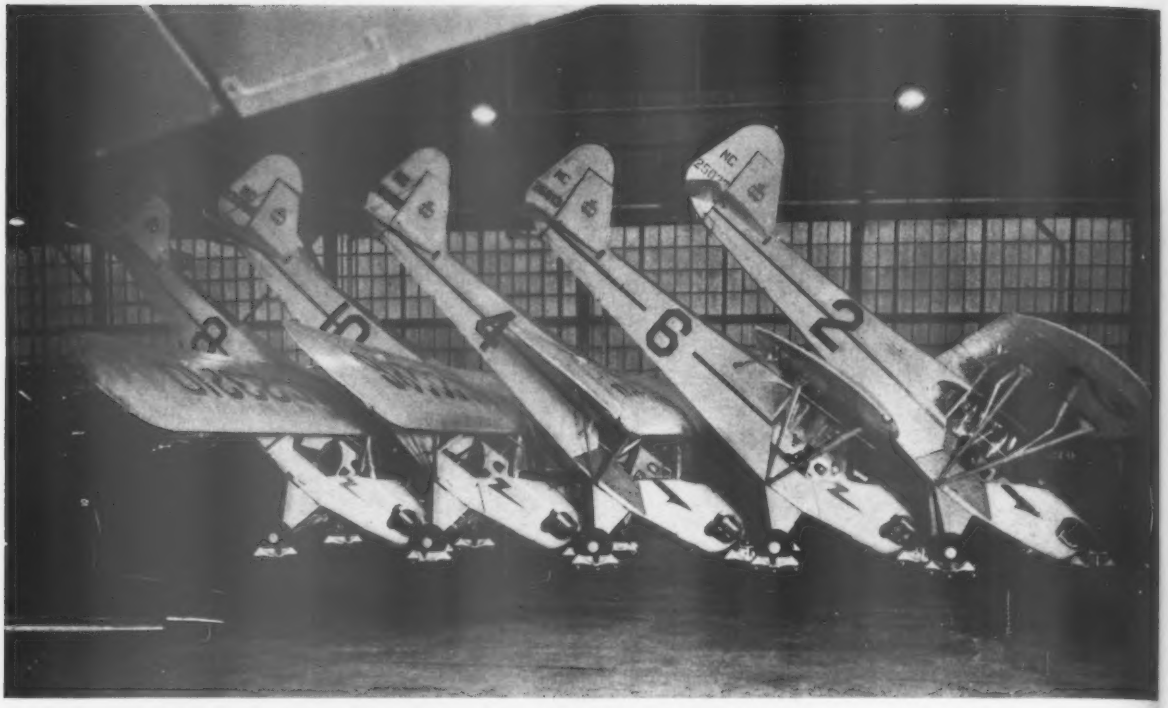
The famous Piper L-4 "Grasshopper" plane, noted for its observation, communication and liaison work with the Armed Forces, does these jobs just as efficiently in snow-bound territory. Replacing its wheels with skis, it becomes a Snow "Grasshopper." The varied wartime experience of Piper planes paves the way to a finer peacetime Piper Cub for you.



PIPER *Cub*

Points the Way to Wings for All Americans

FREE BOOKLET ON HOW TO FLY. Send today for your copy of the easy-to-understand booklet "You, Too, Can Fly!" If you also want the full-color Piper catalog, enclose 10c in stamps or coin for postage-handling. Piper Aircraft Corporation, Dept. PA93, Lock Haven, Pennsylvania.



When planes are stored tilted, as these Piper "Cubs," moisture has no chance to drain out at the tail post.

IF YOUR PLANE HAS BEEN STORED

by Alma Heflin McCormick

Careful reconditioning and checking are advisable before the aircraft can be put back into service.

WHEN bombs fell on Pearl Harbor the problem of maintenance and care of immobilized aircraft dropped straight into the lap of a large number of American flyers. When fields remained closed to private flying the problem was taken largely out of the pilots' hands, because many planes were dismantled for storage. Some had no radio equipment on their planes, some had no radio licenses, some had not the time for the involved business of getting clearances for XC and were not interested in flying within the three mile limit.

Increasing Civil Air Patrol activity has called many of those immobilized planes back to service. It is important that they have a careful check and reconditioning before being put to use for the varied duties of patrol flight.

The engine is No. 1 on the check list. If the plane is not yet in actual use and is standing idle, the owner should make a point of seeing that the prop is swung occasionally and, at intervals, the engine run in for a few minutes. This assures that the oil film which coats the cylinder walls is not going to gradually drain away, causing the pistons to score and scratch when the engine does go into service. Pistons, valves and other moving parts will be guarded against sticking and, if the plane is stored where dirt is a problem, it will partially protect the oil from gumming moving parts.

When the engine is to be used in flight again, it is a good idea to drain out all the oil and flush with a very light oil. The speed should be kept low and, when the engine has been flushed, this light oil should be replaced with the weight standard for the season.

If the plane has been stored with the gas tanks only partially filled, it is probable that water vapor in the air has condensed in the tank and lines. The gasculator is designed to strain this water out before it reaches the carburetor, but it can work only so far. Check the gasculator. If the glass cup holds any water—and it may be completely full—turn off the gasoline at the shut-off and remove, empty and clean the cup. Clean the strainer, replace it and turn the gas on. Sometimes the cup will again fill with water. If this happens more than once, it is a good practice to open the shut-off and let the gasoline drain freely for a moment before replacing the gasculator.

The water will be at the bottom of the tank, below the lighter gasoline, but if there is a great deal of water the pilot will find it desirable to drain the tank completely, tipping the plane to be sure of getting the last drop of liquid, and then straining the gas through a chamois.

Check against mud or sediment. I have, on occasions, found as much as half an inch of red mud collected in a tank after a long trip through a "cow pasture itinerary." Sometimes this can be cleared by rocking the ship until it is stirred up so that it will drain out, but if it is really bad, it may be wise to take out the tank and have it cleaned under pressure.

Incidentally, the gasoline in the lower octane ratings is of poorer quality now that the best grades are being taken for war use. The engine companies have sent out bulletins warning against lead in

Freight Laden Glider Towed Across Ocean
LONDON, July 5 [Monday]—A freight loaded glider recently was towed across the Atlantic in a successful test of a "sky train" technique opening great new possibilities in air transport, the air ministry disclosed today.
The Glider was loaded with vaccines for Russia, radio, aircraft and motor parts, and was towed by a twin engined Douglas C-47 transport, a type which the Dakota. It completed journey in 28 hou
The glider
Known as type CG4A, it was designed by the Waco Aircraft company and built by a New York manufacturer.
Months of Experimenting

Another WACO FIRST

Throughout its long association with the aviation industry, WACO's role has been that of the pioneer. In more than two decades of peace-time development, a long procession of sturdy, easy-to-fly WACO planes led the way in removing flying from the "stunt" category . . . in securing its recognition as a normal, everyday activity for thousands of men and women.

War has not changed WACO's role in aviation, merely its product. For with the recent transatlantic crossing of a cargo-carrying glider, WACO has scored another first in flying. This ocean-spanning glider—towed by a standard twin-engine transport plane and laden with vital supplies for our allies—was designed by WACO for the Army Air Forces and is now being manufactured by WACO and fifteen other plants using WACO design and engineering supervision.

Similar gliders are today transporting fighting men and munitions to fighting fronts everywhere. They will exert an important influence upon the course of this war . . . just as you can depend upon their designer, WACO, to continue as an important influence upon the course of aviation when this war is won.

ALL ARMY CARGO-TRANSPORT GLIDERS ARE WACO DESIGNED

WACO AIRPLANES

THE WACO AIRCRAFT COMPANY • TROY, OHIO • U. S. A.

gasoline. It will foul valves at an amazing speed. Engines should be watched a good deal more closely these days, and overhauls at least every *100 hours* is a standard precaution.

After tanks and lines are cleared, precautions should be taken against gathering more water. If the tank is always filled immediately on landing, the air with water vapor is driven out. A cloth tied loosely around the gauge wire on the planes having that type of gas gauge will keep water from running down the wire into the tank in case of rain or heavy dew.

The manual with each plane gives the optimum pressure for tires, which should be filled with something over the recommended poundage of air, and then the excess released slowly until the gauge reads correctly. The pressure should be the same on both wheels to guard against bad landings and to keep wear even.

Alignment of wheels should be carefully checked, the simplest method being measurement with a cord from a central point on the fuselage out to each tire. Since an airplane's wheels have a slight toe-in, wear can be evened by occasionally switching tires. They can be further protected by careful use of the brakes. Many pilots have a habit of riding the brakes to guide the ship while taxiing. With a steerable tailwheel and careful use of rudder, aileron and throttle, this is unnecessary. Where runways are long enough for safety, burning the rubber can be minimized by letting the plane lose momentum in the landing roll instead of standing on the brakes almost as soon as the wheels touch the ground.

If possible, the plane should not be parked in the hot sun. The sun can be as dangerous to finish and windshields as to tires. It is hard to protect dope from sun damage if there is no choice but to leave the plane outside, but a cover can be tied over the plastic windshields if the plane is to be parked outside, even if just for a few hours.

The weather can be as hard on a grounded plane as a saboteur. Canvas should cover pyralin surfaces, and a canvas sock be tied over the propeller. An additional precaution to prevent collection of moisture which would swell and warp the laminated propeller is simple: it is turned so that moisture can drain out through the small perforations you see in the metal tipping.

The tubing in the fuselage of most modern airplanes is protected against rust with an oil treatment and priming, but before a stored plane is flown a careful inspection should be made to see that the drain holes are open at the tail post, and if the plane has been stored by tipping it up on its nose (as small planes frequently are in crowded hangars) it should be put back into normal position for awhile to let the moisture drain out. Of course all joints that can be seen through inspection windows should be carefully checked, especially at places where tail or wing fittings are located.

Control cables should have an inspection against possible rust. A bare hand rubbed along the cable wherever you can reach it will detect a broken strand that might escape the eye. Manifolds should be checked for any rusted, thin or burned places that might permit a gasoline vapor or an exhaust gas leak; and a final check should be made of the whole plane to see that all safeties and safety wires are in place.

After being stored for a long period, the compass will probably be off. A check should be made by a qualified instrument man if you can manage it. Otherwise, the plane can be set up in flying position, its tail on a sawhorse, the engine started, and the compass set by moving the small magnets or turning the set-screws (according to the type of compass you have) until the errors are removed or divided evenly between the opposite directions indicated. If no compass rose is available, a substitute can be devised until you can get the plane to a better equipped base. Away from a metal building that would cause deviation, lay out a temporary rose with a hand compass and check against this.

A test flight should be made on any plane that has not been flown for as much as a month. Any doped fabric will dry out progressively as the plane ages, and such drying means that the airfoil section of the wings may change—and not evenly. You may find on this test flight that the plane which flew perfectly the last time up now has a decided wing-heaviness to one side or the other.

Wing-heaviness is ordinarily corrected by washing-in the light wing. This is done by taking out the bolt which holds the rear strut to the fuselage fitting. The member which screws into the strut is then screwed *in* another thread or two. Occasionally you can screw it in as many as nine full turns. Just how much wash-in you need is a matter of the pilot's individual experience.

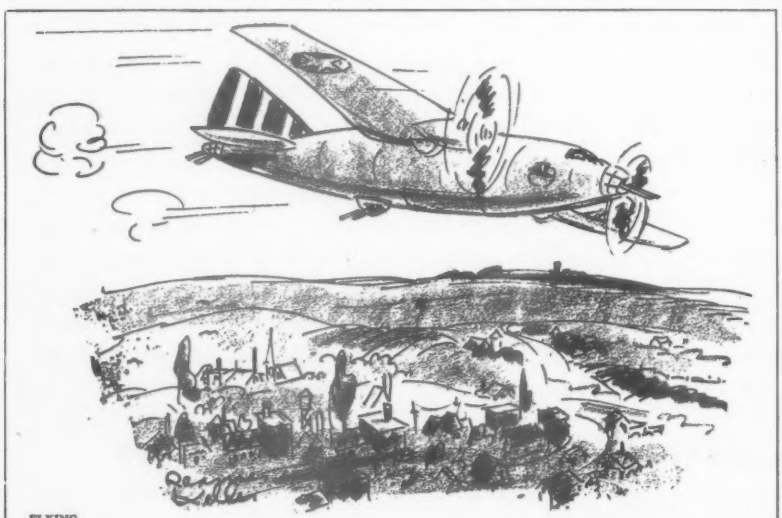
A pilot and mechanic who have had little or no experience in re-rigging a plane for flight can do the job best by experiment—a few turns, a test flight, perhaps a few more turns. If there are not enough threads visible to make full correction by washing-in the light wing, the heavy wing can be "washed-out;" that is, the member in the *heavy* wing can be screwed *out* until the plane is in balance.

The pilot and mechanic should make it a point when washing-in a light wing to try to get it exactly correct *by working on that wing only*. That is, if they find they have washed-in that wing *too* much, then they should *unscrew* some of the threads on that *same* wing. Otherwise, they may find the wing has become heavy, and unthinkingly correct by washing the opposite wing in too. If both wings are washed-in extensively, the pilot may find to his dismay that the plane's spin characteristics have changed considerably. Instead of a normal spin, a plane with excessive wash-in on both wings will tuck its nose under and spin almost vertically, reeling off 400 to 600 feet in a turn at a terrifying speed instead of the normal 200 feet or so.

No plane should be considered ready for service until it spins at a reasonable speed at the normal angle. A spin that is flat or difficult to get into often proves difficult to recover from. If the spin is steep and fast, there may not be time to recover before a crash.

Spins are a more or less complex aerodynamic problem and should be treated with respect. Roughly, however, the pilot and mechanic can control the speed and angle. Washing-in the rear strut on *both* wings will steepen the spin. Washing-out both rear struts will flatten the spin. When you have completed *that* little chore of making the spin to suit, you will probably find that you have again rigged the plane to fly with one wing low—and start rigging for level flight again.

But eventually, by patient test flying and adjustment, you will have the plane ready for service. END



"You take the controls when we pass over my landlord's house—I'm afraid I might do something rash!"

"Betcha Dad worked on those engines!"

They're talking about a Flying Fortress powered by Studebaker-built Wright Cyclone engines

JUST a little while back, expert machinist John H. Williams and his two sons, Evard and John, were working together at Studebaker.

Today, they're still working together in spirit—but many miles apart.

The father is building Wright Cyclone engines for the mighty Boeing Flying Fortress in the Studebaker factory. The boys have hung up their working clothes to put on the fighting uniforms of Uncle Sam.

There are many families such as the Williams family whose names shine brightly these war days on the Studebaker roster—families that are steadfastly maintaining the great Studebaker father-and-son tradition at home or far away.

And when the fighting job is done, that tradition will be exemplified again in outstanding Studebaker motor cars and motor trucks for civilian use. The solid principles that underlie Studebaker craftsmanship will remain unchanged.

BUY U. S. WAR BONDS

STUDEBAKER

Builder of Wright Cyclone engines for the Boeing Flying Fortress, big multiple-drive military trucks and other vital war materiel

Craftsmen father of craftsmen sons! John H Williams has been with Studebaker 21 years. He is one of many Studebaker veterans whose aptitude for fine work inspired their sons to become Studebaker craftsmen, too. Studebaker employees are proud of their assignments in the arming of our Nation and its Allies.

Perfect Circle has once again written
a new page in piston ring history.

Leadership, in war or peace, places a responsibility upon any organization. Perfect Circle is maintaining its leadership in the aviation industry as it has for so many years in the automotive industry. Today Perfect Circle is manufacturing millions of aircraft piston rings designed to meet the most exacting requirements of those who make the world's finest aircraft engines.

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Hagerstown, Indiana • Richmond, Indiana • Newcastle, Indiana • Tipton, Indiana • Toronto, Ontario, Canada

Letters

APPRECIATION

SIRS:

"I should like to express my appreciation of . . . your magazine FLYING. . . . Wherever I happen to be, it is received by myself and my friends with great enthusiasm.

"We read with interest both the articles on American aviation and those on our own aircraft and it is very gratifying to find so many of the latter in recent issues.

"Your magazine is the only connection we have with the achievements of American industry and is the only source we have of such detailed or technical information."

SGT. PILOT V. SCHOOLING
Royal Air Force
London

● Our thanks to Sergeant Pilot Schooling.—ED.

"MAE WESTS" VS. PARACHUTES

SIRS:

"I noticed something [in a recent issue] that I don't understand and I would appreciate your clearing it up. The picture shows a Navy pilot entering a Grumman *Wildcat*. He has his Mae West (life vest) under his parachute. When I was taking my gunnery practice we were told to wear them over the parachute. It seems to me that in case of emergency the parachute harness would keep the life vest from inflating fully. Could you clear this matter up for me?"

SGT. CHARLES WOODFORD
396th Bombardment Squardron
Moses Lake, Wash.

● Sergeant Woodford apparently is thinking of a disabled plane landing in the water, in which circumstance it would be necessary for the pilot to disengage his parachute before inflating his life vest. Wearing life vests under the parachute is Navy regulation, however, since the chute might not open readily if the vest is worn over it. The parachute is disengaged just before the pilot hits the water and the belt is then inflated.—ED.

"WASH RIDE" FAN

SIRS:

"I realize only too well it is not a woman's place to stick her nose into a man's flying magazine—particularly if she knows next to nothing about flying—but my husband is a cadet and I couldn't resist reading Lieut. Richard Ryan's article, 'Wash Ride,' in your June issue.

"My husband happens to be very close-mouthed about everything. He may casually mention he passed his Army check ride—or he went on a cross-country a few days ago. But until I read Lieutenant Ryan's article I had no idea just how much blood he did sweat out on the flight line.

"Lieutenant Ryan, we cadet wives enjoy reading articles that give us an insight into just what makes the wheels go round. We're in this war too, in our own way, so tell us more about these 'gadgets.' Our husbands won't tell us so we're depending on you."

MRS. MARJORIE GUILLEN
Los Angeles

● We are pleased to know that at least one wife has a better insight into just what her husband is going through in his flight training program through Lieutenant Ryan's article. A new book by Lieutenant Ryan, "Spin in, Dumwhacks," tells the whole story of how he sprouted wings. Incidentally, Mrs. Guillen, FLYING is not particularly a "man's" flying magazine—it is everyone's flying magazine.—ED.

THE FIFINELLAS

SIRS:

"This headquarters was very much interested in the story 'The Fifinellas' by Barbara Selby in your July issue.

"There is one point, however, that we believe should be brought to your attention. The Women's Flying Training Program is under the jurisdiction of the Army Air Forces Flying Training Command (Maj. Gen. Barton K. Yount, commanding general), and not under the Air Transport Command. We feel that it is important for the public, and especially women who plan to join the Women's Flying Training Program, to know under whose auspices the training is being given, since there exists a great deal of confusion concerning this point. We, therefore, would appreciate it, in any future stories about the Women's Flying Training Program, if you would point out that the training is provided under the jurisdiction of the Army Air Forces Flying Training Command, and that upon graduation the women pilots are transferred to the Air Transport Command, where their duties in ferrying planes will begin.

"Except for this matter, we felt that Miss Selby did an admirable job of presenting the women's pilot story."

MAJ. FRANCIS C. HEALEY
Army Air Forces Flying
Training Command
Forth Worth, Tex.

TIP TO ADVERTISERS

Sirs:

May I enlist your aid to urge commercial advertisers in non-flying magazines who use pictures of aircraft . . . to label each plane with the lettered serial number and popular name? This would greatly aid Army personnel . . .

CARL BLEIBERG
Lieutenant C. A. C.
Camp Stewart, Ga.

FLYING

"Moorhead, would you mind stepping outside with me?"

RUGGED

through and through!

THE *TIMM* AEROMOLD *NAVY TUTOR*

N2T-1

Built exclusively for the United States Navy, these trim N2T-1 Timm Training Planes are fabricated of plastic-bonded plywood by the famous Timm Aeromold Process. Their smooth lines, rugged strength and thorough engineering are typically NAVY... their performance appeals to pilots... their ease of upkeep and repair to maintenance crews.

TIMM AEROMOLD

Timm is also the only Pacific Coast manufacturer of CG4A Troop Transport Gliders for the Army, and the Timm Metal Fabrication Division supplies parts for combat airplanes manufactured by Douglas, Consolidated-Vultee, Lockheed-Vega and others.

TIMM

TIMM AIRCRAFT CORPORATION
LOS ANGELES, CALIFORNIA

This Northrop-designed-and-built "Gamma" flew the peaceful skies of 1936 as TWA's famous "overweather laboratory". Its discoveries in the stratosphere add to the safety and battle score of every boy now flying the six-mile-high bombing roads to Axis cities—and back

In this Northrop "Gamma" the U. S. learned about 6-mile-high flying

Seven years ago Transcontinental & Western Air, Inc. wanted to know if a transport plane could escape storms by flying "over the weather". There was almost no data at hand, for only a few exploratory high-altitude airplane flights had been made earlier. TWA's research pilot, D. W. Tomlinson, undertook the job.

Tomlinson's first experimental flights were made at ceilings around 20,000 feet. Then, late in 1936, the U.S. Army loaned TWA a special supercharger which was installed in the swiftest single-motored mail plane then known — the Northrop "Gamma". (It had flown the mail from Burbank, California to Newark, New Jersey in less than 12 hours.)

In this sturdy Gamma, designed and built by the Northrop group, came the flights that taught America what stratosphere planes of today would have to do. Repeatedly, Tomlinson and his fellow scientists explored the upper air between Kansas City and Newark. Some of their transport flights were ceilinged at over 37,000 feet!

More. This "overweather laboratory" took the air *in storms that had grounded all regular transports.* It would rise above the storm's center, determine how to get past safely, with least expenditure of fuel and time.

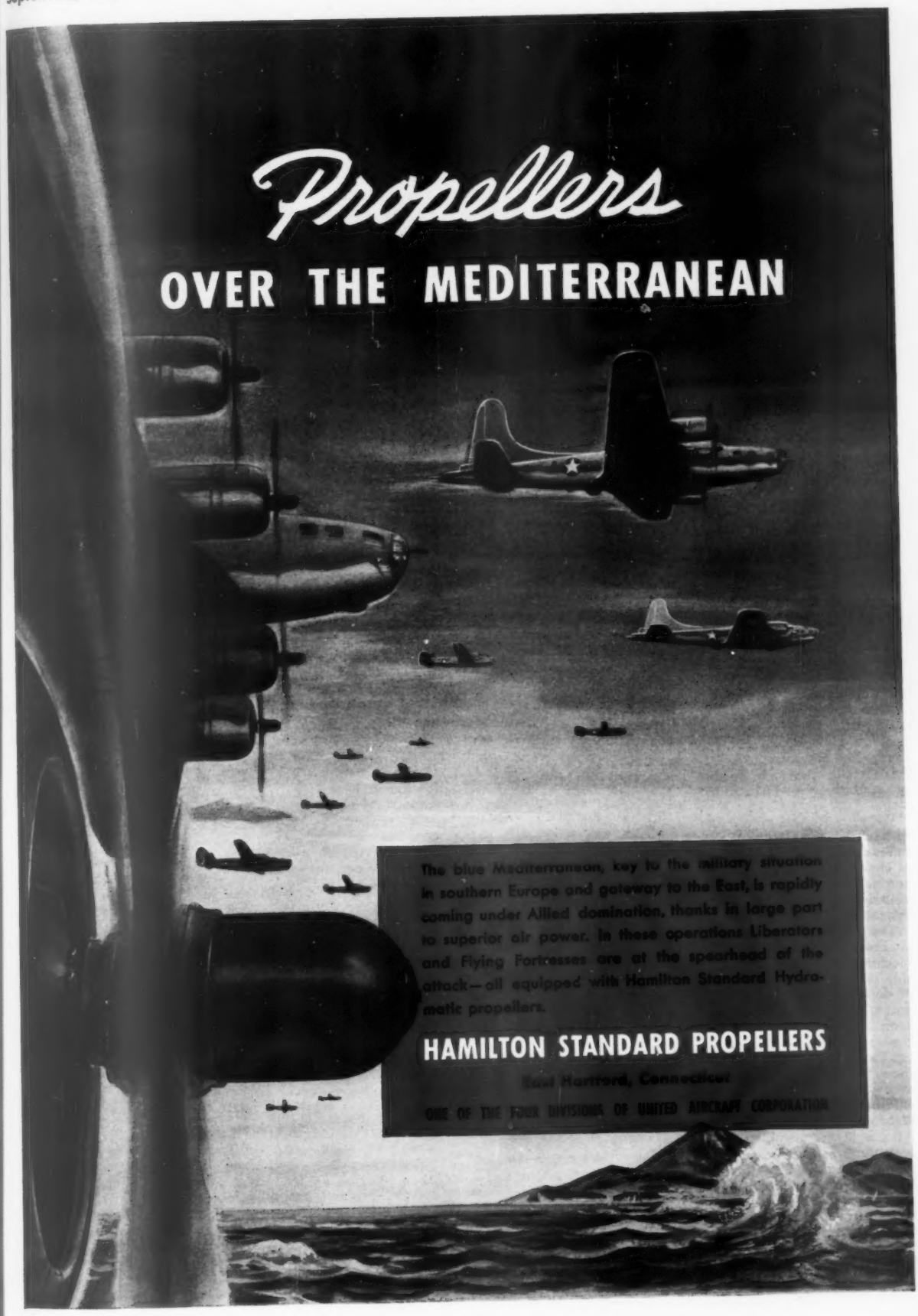
Mind you, this was a *commercial* project... not set up to pioneer a bombing road to Berlin or Tokio. Yet it laid a vital part of the foundation on which U.S. pilots now travel the 6-mile-high bombing roads to enemy objectives.

That's the record of a famed Northrop-designed airplane of the past. In the all-consuming present, the group which designed and built the Gamma is at work night and day. Grown now to many thousands of men and women, this Northrop group is turning out more and more warplanes — of striking power more deadly than most men can imagine. AND THIS IS ONLY THE BEGINNING.

NORTHROP *Aircraft, Inc.*

NORTHROP FIELD, HAWTHORNE, CALIFORNIA

MEMBER AIRCRAFT WAR PRODUCTION COUNCIL, INC.


Propellers
OVER THE MEDITERRANEAN
The blue Mediterranean, key to the military situation in southern Europe and gateway to the East, is rapidly coming under Allied domination, thanks in large part to superior air power. In these operations Liberators and Flying Fortresses are at the spearhead of the attack—all equipped with Hamilton Standard Hydromatic propellers.
HAMILTON STANDARD PROPELLERS
East Hartford, Connecticut
ONE OF THE FOUR DIVISIONS OF UNITED AIRCRAFT CORPORATION

AIRCRAFT OWNERS AND PILOTS ASSOCIATION

AOPA NEWS

The Aircraft Owners and Pilots Association (AOPA) with National Service Office located in the Carpenters Bldg., Washington, and Registrar's Office in the Michigan Square Bldg., Chicago, is a non-profit organization composed exclusively of pilots. It looks after the pilot's best interests in all phases of aviation and helps individual pilots with their individual problems. The AOPA operates with a full-time professional staff and is the largest group of civilian pilots in the world. This column is edited by the Aircraft Owners and Pilots Association and opinions contained in it are not necessarily those of FLYING. A special Bulletin is sent each month to all registered AOPA pilots and also confidential memorandums from AOPA's Washington staff are sent members from time to time.

WE ARE pleased to report that AOPA pilot registration is continuing on the upgrade. There are more active pilots in the AOPA now than this time last year in spite of the war having taken hundreds of AOPA pilots into the military services. As a matter of fact, AOPA has been able to render to its members in the armed forces valuable assistance and services which have probably accounted for their continued active membership.

CHANGES IN CHARTS

Not all pilots have been able to obtain aeronautical charts of the Coast and Geodetic Survey recently because they have been classified as "restricted" by military authorities and are available only to those engaged in active war work.

Many changes have taken place on these charts and, in our opinion, the majority of these changes are in the interest of clearer map reading and better navigation.

We previously reported the narrowing of civil airways from the width of 20 miles down to 10 miles. This change has, of course, been reflected on new issues of aeronautical charts. The airways are now bounded by narrower lines but of greater ink intensity.

The manner of plotting range-approach channels has been simplified. In place of blocking out rectangular areas on either side of the on-course signal as a means of denoting the channel, the line designating the width of the airway has merely been moved inward towards the on-course signal, thereby, in effect, narrowing the airway. A dotted line is used to show the outer extremity of the airway over which the CAA has jurisdiction to enforce civil air regulations pertaining to flight within the civil airways.

Some of the aeronautical charts have been published with the aerial navigation aids in a purple-blue overlay in lieu of the red overlay with which AOPA pilots are familiar. This means that the airway limits, airports, radio-range stations, traffic-control zones, fan markers, airway beacons, etc., all appear in a dark blue ink. This type of map has been adopted principally for night flying where new types of cockpit lights are employed which tend to make the old red overlay become invisible or difficult to read.

Caution areas, danger areas, prohibited areas, range-approach channels, and tunnels all have new simplified symbols and are accurately plotted to assist pilots in avoiding areas where hazardous defense activities or heavy concentrations of aircraft exist.

AOPA has learned that additional changes are now being studied. A new and improved map base has been adopted which not only modernizes the terrain details (including new roads, land marks, etc.) but also, by improved symbols and map cartography, more clearly registers map features. Also contemplated, we are told, is a means of indicating on the map not only the location of airports but also the direction and length of runways, type of runways, facilities offered at the airport for transient aircraft, etc. AOPA has long advocated this latter step and it is hoped that future editions of all aeronautical charts will carry this vital information.

At war's end a new and greatly improved aeronautical navigation chart will be available to non-scheduled pilots.

ABOUT PILOT CERTIFICATES

AOPA continues to receive many inquiries from worried pilots asking whether their pilot certificates are still valid. In the majority of cases the answer is found to be yes. For particulars of the various regulations (and a new medical provision for men in service) see the AOPA *Pilot* this month. (AOPA *Pilot* is the confidential news bulletin sent to all registered members each month.)

The basic rule is that, if a pilot certificate was valid as of April 1, 1942, it will perpetuate itself, and to resume flying a pilot need only pass a new medical examination and complete a prescribed number of take-offs and landings. Other questions have been sent to AOPA from pilots in service who have built up their original time while in the armed forces and who wish to obtain a civilian pilot rating. AOPA will be glad to assist pilots in taking this step. Inquiries should be forwarded to the AOPA National Service Office, Carpenters Building, Washington 1, D. C.

AOPA-HERTZ PRIVILEGES

One of the many services which AOPA pilots enjoy is the privilege of renting Hertz Driv-Ur-Self cars at special rates and without the necessity of leaving a cash deposit. Some members have erroneously come to the conclusion that this service has been discontinued due to the war. This is not the case.

We are happy to announce that the AOPA-Hertz Driv-Ur-Self plan is still in operation, and all registered pilots whose membership in AOPA is currently active may obtain Hertz cars in all principal cities upon presentation of the special AOPA-Hertz card which has been provided for the convenience of each AOPA pilot-member.

MEMBERSHIP SERVICE

AOPA each month handles many requests from AOPA members for jobs, for airplanes, or for information regarding aviation activities. These are carefully filed and indexed and many hundreds of AOPA pilots have secured positions, aircraft and aircraft parts through the facilities of the AOPA office.

Sometimes we mention typical cases in this column. For instance, an AOPA member with a flight instructor's rating, now in Florida, desires information on schools requiring instructors in any of the following states: New York, New Jersey, Michigan, Pennsylvania, Connecticut, or Rhode Island.

Any AOPA operator desiring an addition to his staff should write to the AOPA and we will put him in touch with the inquiring member.

GRASS FOR AIRPORTS

About a year ago, in response to requests from AOPA pilots who maintain their own airports and in conjunction with the development of AOPA's "Airhaven" idea, we published in these pages a detailed description of the types of grass seed that should be planted in combination with others in different climatic belts of the U. S. and under different types of soil conditions.

AOPA's adviser on this subject, Dr. John Monteith, Jr., chief of the turf unit in the Construction Branch, U. S. Army Engineer Corps, has been doing some additional research, most recently in connection with the New Zealand Department of Scientific and Industrial Research. Officials in New Zealand have also found a common relationship between turf for airfields and that on golf courses.

One paragraph containing some specific suggestions is quoted for the information of airport operators:

"From observations to date there is fairly clear-cut evidence that the type of turf most suited to aerodromes which are required to stand hard wear is that class of turf most closely approaching a playing green or lawn. The pasture species such as ryegrass and white clover are definitely unsuited to hard regular wear. Some other drastic treatments will be necessary to convert the pasture type of turf to a good hard-wearing mat.

"Some considerable expenditure will also be necessary to control white clover which up to now has been fairly well established but is already proving to be quite dangerous. Supplies of grass seed suitable for aerodromes have been secured, the main species needed for this work being Chewings' fescue, certified browntop, Poa pratensis, and yarrow. In addition, according to soil type and climate, there is need for some creeping-bent seed and dryland browntop seed. At one particular aerodrome site Pucchellia was sown and a further quantity of this seed is to be sown now." END

The War...And You!

Friend—don't think this war doesn't affect you. It does. It's pushing the world twenty years ahead of time; stimulating the development of devices you may now be making or using. After the war, the average American's life is destined to be fuller, more exciting, more comfortable due to these new products. And just as Weatherhead has helped build the nation's automobiles, airplanes and refrigerators in the past, peace will find us prepared to join you in building these established products as well as the many new ones certain to come out of the war.

Look Ahead with

Weatherhead

THE WEATHERHEAD COMPANY, CLEVELAND, OHIO

Manufacturers of vital parts for the automotive, aviation, refrigeration and other key industries.

Plants: Cleveland, Columbia City, Ind., Los Angeles
Canada—St. Thomas, Ontario

London Survey

(*Continued from page 57*)

data on which these estimates are based is fairly clear cut once it can be sorted out. The purpose of the rest of this article is to make these estimates clear and put them forward as a basis upon which calculations for the future can be founded —always remembering the existence of the law of diminishing returns. These figures and calculations have been checked independently by authoritative sources and may be taken as conservative.

All warfare today comes down to a foundation of man-hours. Germany has an able-bodied working population, including slave labor of some 47 million men and women out of a total population of 78 million. They may be subdivided as follows:

Services ..... 9.5 million (20 per cent)
Direct war production ..... 7.0 million (15 per cent)
Agriculture ....11.5 million (25 per cent)
Civil occupations,
Transport, etc. 19.0 million (40 per cent)

German manpower is in fact extended to the uttermost. Remove men from agriculture and the nation starves. Remove men from the civil occupations and transport fails, administration ceases, the general economic life breaks down. The number of youths arriving at the age for military service each year is insufficient to make good the losses. Therefore there is no margin left for emergency calls and the importation of slave labor can barely keep pace with vital necessities, quite apart from bombing.

When we examine this point in more detail we find that German manpower can be divided into two main groups in the face of air attack. In the first group are the services and the agricultural workers. This group of 21 million is not directly affected by bombing. The second group of war workers and the home front, amounting to 26 million, is directly influenced by bombing. On it falls the moral effect and the need to make good the damage.

A fundamental fact is that the manpower necessary to replace and repair the damage to vital installations governs the effect that bombing can have on a nation's war effort. German bombing of Great Britain in 1940 did not achieve decisive results because—apart from being badly directed—there was still plenty of free manpower available to deal with it. Not so in Germany today. The Reich is stretched to the limit and this stretching reflects itself in the fact that the 19 million workers in civil occupations are the very minimum needed to keep the national economic machine in the condition necessary to produce a sustained war effort, while the other 28 million produce the food, man the armed forces and turn out the weapons of war.

Thus when bombing is imposed on this strained war machine the German administration is faced with an unenviable predicament. Bombing must be met either by a reduction of the production of weapons or by a letting up in the maintenance of the civil machine.

In other words, no margin has been left for contingencies—doubtless relying on Goering's boast that "no foreign airplane would live to let fall a bomb on the Reich." Now, when these contingencies in fact arise, the German war machine has the choice of three evils. It must either:

(1) Divert men from the production of munitions to repair work at the direct and immediate expense of supplies to the armed forces.

(2) Take the necessary resources from the civil labor force at the expense of other activities necessary to maintain the efficiency of the war machine, or

(3) Leave the damage unrepaired.

The difference in effect of each of these measures is a difference only of time. The first choice affects war production immediately, the third choice affects it a little later. If, as appears to happen most frequently, the second choice is adopted then it can only postpone the crisis by mortgaging the future. It cannot avert the crash. When the crash does come it will be all the greater for the breakdown of the home front.

The meaning of all this is that the task of making good the bomb damage falls, in effect, on seven million German and foreign workers, either directly or by transfer of burden. In Germany today each workman normally does an average of 50 hours work per week for 50 weeks per year, including absence on account of sickness or other reasons. This average totals 2,500 hours of work per person per year, the real value of which, incidentally, is going down as war weariness—and particularly bomb weariness—overtakes the population. On this basis the seven million who are engaged directly on war production, work a total of 17,500 million man-hours per year—that is, 1,460 million man-hours per month. Similarly the 19 million in essential civil industries work a total of 47,500 million man-hours per year or 3,960 million man-hours per month.

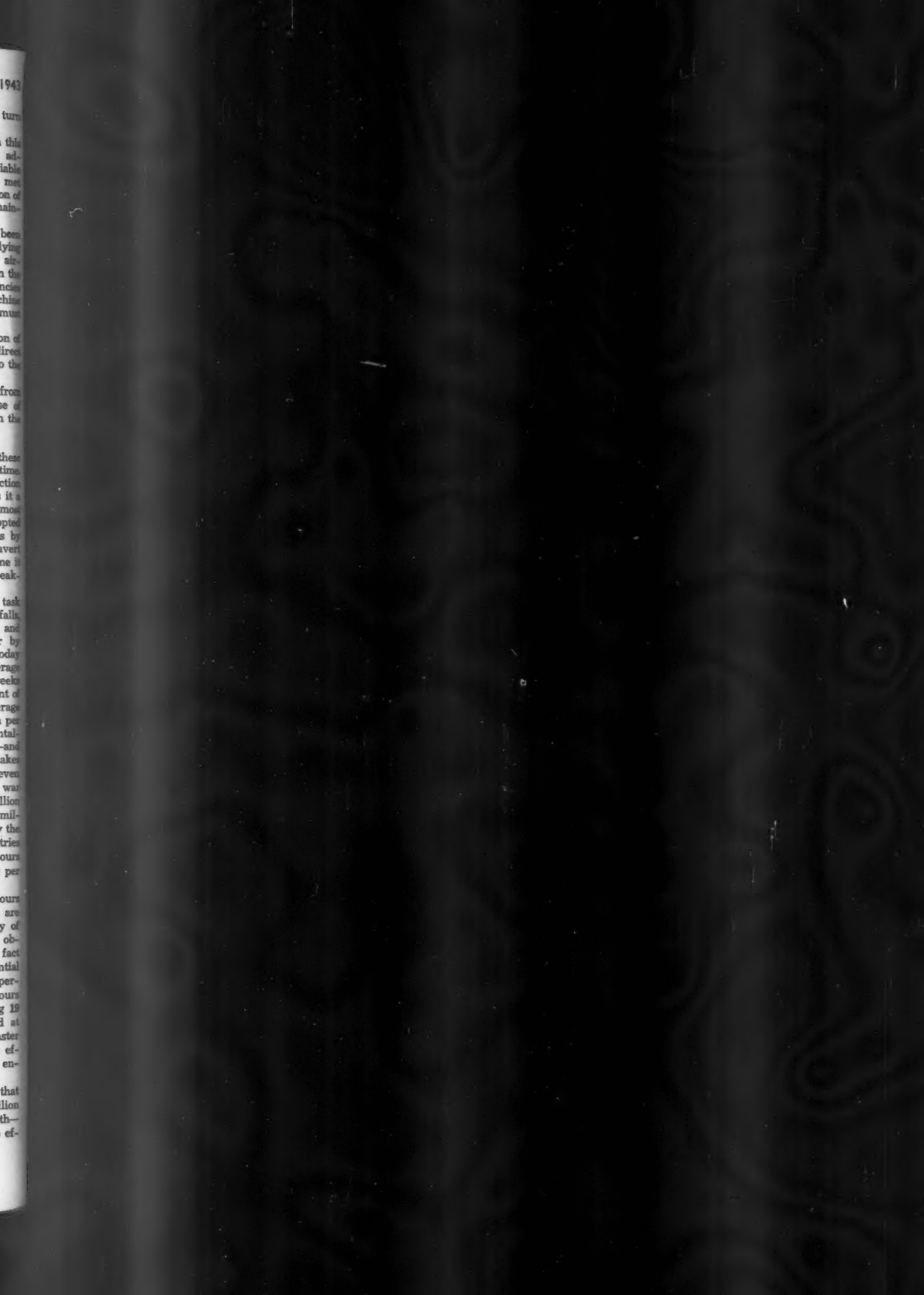
Obviously if the 1,460 million man-hours per month of direct war production are destroyed or disorganized the supply of munitions to the front will fail. Less obvious, but nevertheless true, is the fact that if a similar burden of extra essential work in the repair of damage is superimposed on the 3,960 million man-hours per month worked by the remaining 19 million, either it must be neglected at the cost of essential and certain disaster or else it must gradually absorb the efforts of the seven million at present engaged on direct war production.

The point of this is that we find that the neutralization of some 1,460 million man-hours of German labor per month—whether by destruction of productive ef-

(*Continued on page 87*)

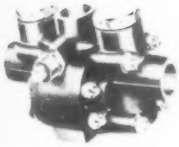
FLYING

"Gee, those guys are in plenty of trouble."



PERFORMANCE CONTROLS THE AIR

Curtiss Helldiver



PESCO Flow Divider
for equalizing
hydraulic pressure.

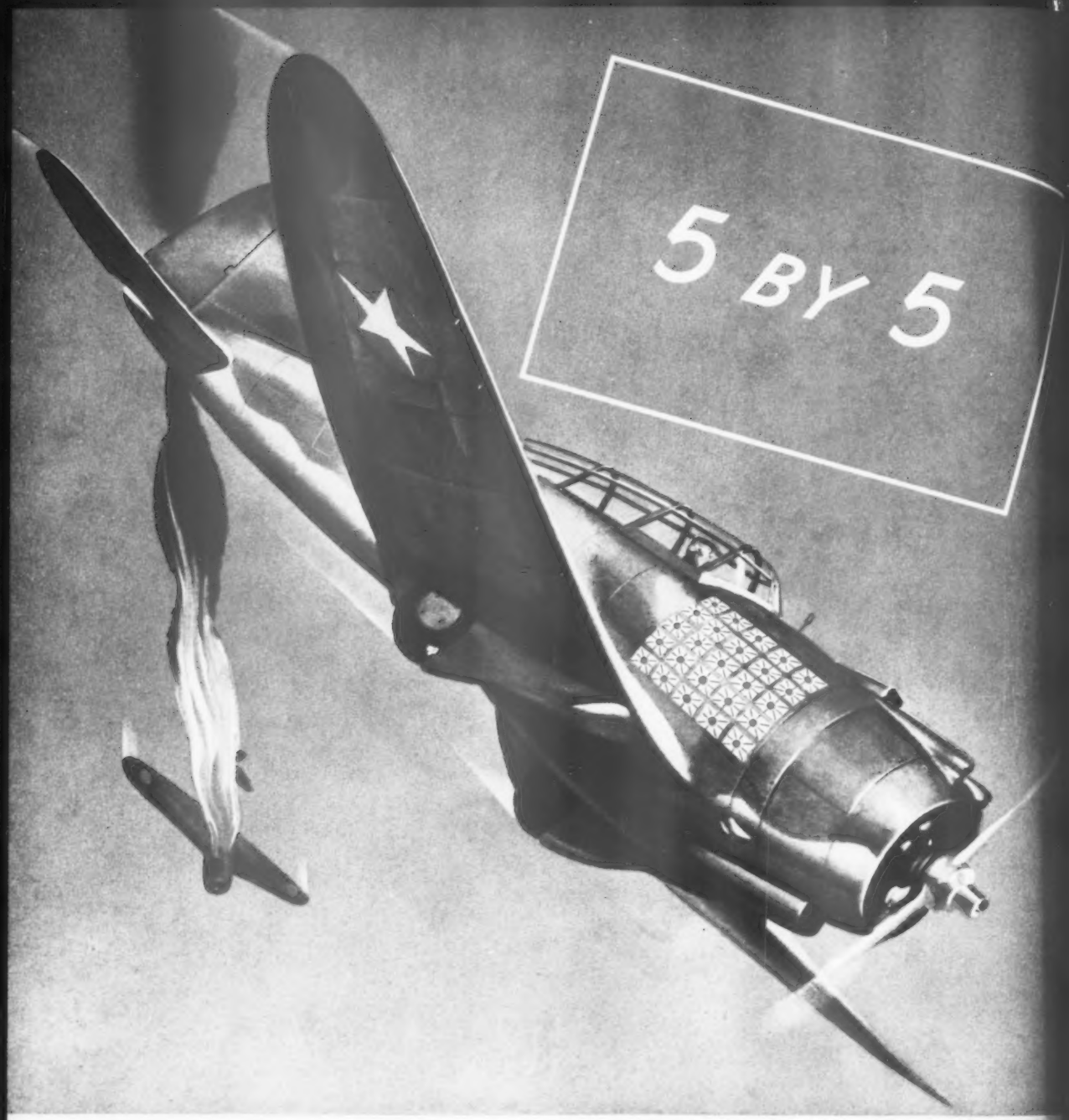
Down they go! Straight down. Peeling off one after another; fingers eager to blast another symbol of hate to the bottom of the sea. With never a thought for themselves, these brave sons of ours pray only that their aim be true . . . that the performance of each plane part be faultless. Here is where the precision of the men who make our planes, and the men who fly them, become a combination that can't be beat!

ARMY E NAVY

In Aircraft Hydraulics, Fuel Pumps, Air Pumps, Related Accessories . . .

PERFORMANCE POINTS TO *Pesco* FIRST

DIVISION BORG-WARNER, CLEVELAND, OHIO



Tomorrow another Jap flag will appear on the side of this fighter—a symbol of the marksmanship of American Aces who are relentlessly and systematically clearing the skies of every zero that dares to come within range of their deadly leaden sting.

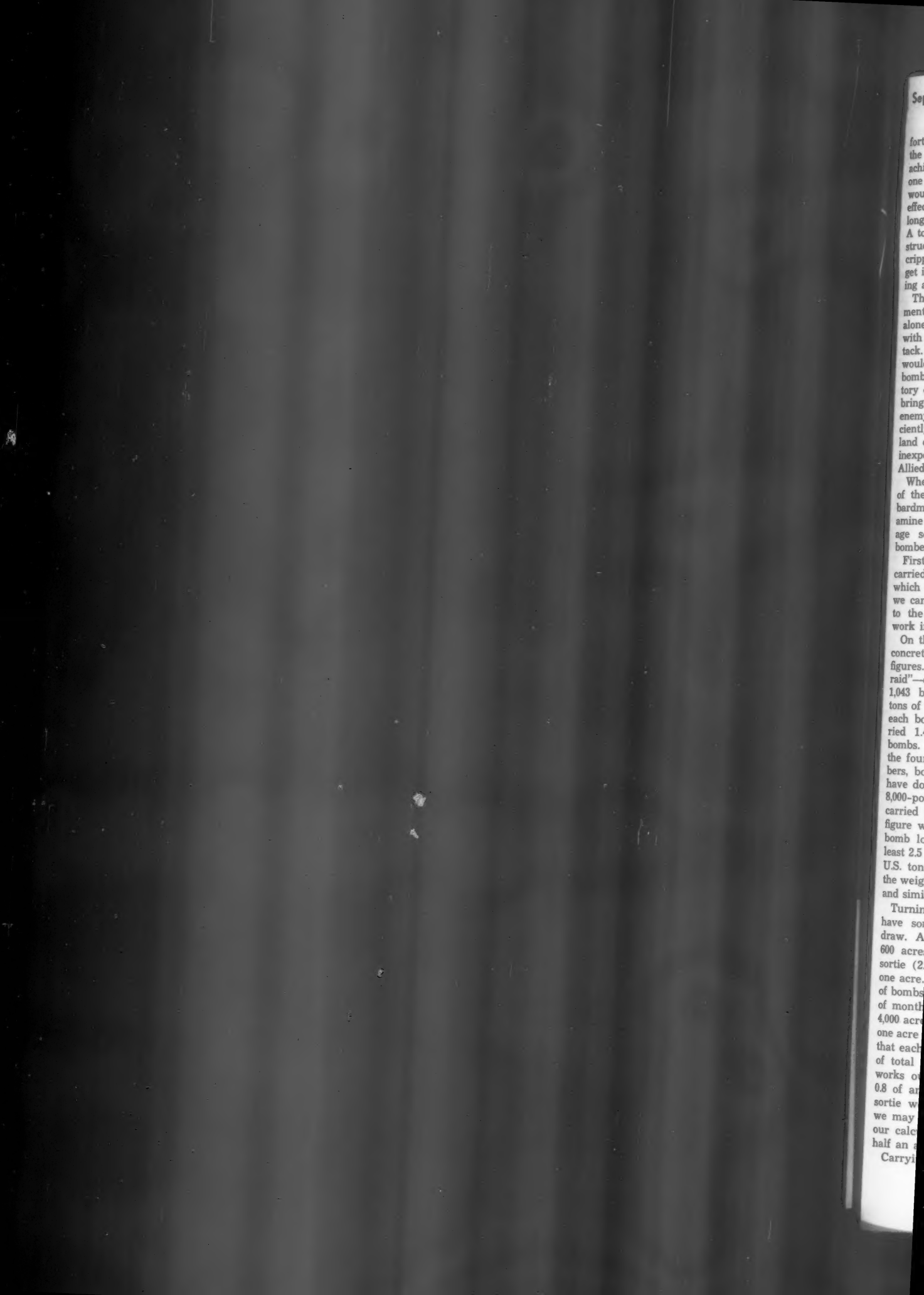
AIRCHOX COMPANY, Division of

JOYCE AVIATION, INC.

And on every front American-made equipment is showing its superiority over the labels "Made in Japan" and "Made in Germany." In this conflict of men and machines, the combination of American ingenuity and courage cannot be whipped.

General Offices, 8 S. Michigan Ave., Chicago

WORLD'S LEADING MANUFACTURERS OF AERONAUTICAL SAFETY EQUIPMENT



(Continued from page 84)

fort or by tying it up in repair work—is the maximum which bombing has to achieve to stop Germany fighting. No one will doubt that in practice the end would come, through the cumulative effect of damage on working efficiency, long before this goal had been attained. A total of 500 million man-hours of destruction per month could not fail to cripple the Reich. That would be the target if the war were to be won by bombing alone.

This fact is not presented as an argument for winning the war by bombing alone—as undoubtedly could be done with closely integrated day and night attack. But it does serve to show what would be needed to win the war by bombing. In reality, invasion and victory on land under cover of the air will bring the end more quickly once the enemy has been "softened-up" sufficiently by air bombardment to make land operations successful and relatively inexpensive. What then, on this basis, has Allied bombing achieved so far?

When we turn to detailed calculations of the destructive effect of night bombardment, for convenience we may examine the destruction caused by an average sortie; that is, one raid by one bomber.

First, we must establish the bomb load carried and then the area of damage which that bomb load causes. From that we can calculate first the loss of output to the enemy and then the increased work imposed on him in repairs.

On the subject of bomb load, we have concrete evidence on which to base the figures. In the RAF's first "1,000-bomber raid"—on May 30, 1942—we know that 1,043 bombers dropped 1,500 (British) tons of bombs on Cologne. On this basis each bomber, of a very mixed lot, carried 1.44 British (1.61 U.S.) tons of bombs. Since then, with the arrival of the four-engined bomber in large numbers, bomb loads are officially stated to have doubled. We know, too, that many 8,000-pound (3.57 British ton) bombs are carried now. Hence, as a conservative figure we can estimate that the average bomb load per night sortie today is at least 2.5 British tons (5,600 pounds = 2.8 U.S. tons) making liberal allowance for the weight of flares, incendiary containers and similar equipment carried at night.

Turning to bomb damage we again have some definite facts on which to draw. At Cologne, 1,500 tons devastated 600 acres. From this we see that one sortie (2.5 British tons) would devastate one acre. The total weight of 10,000 tons of bombs dropped on Essen over a period of months is known to have devastated 4,000 acres. That gives the same figure of one acre per 2.5-ton sortie. We know also that each 4,000 pound bomb has a radius of total destruction of 35 yards; which works out at an area of destruction of 0.8 of an acre. On this basis a 2.5-ton sortie would flatten 1.12 acres. So that we may err on the conservative side in our calculations, let us take a figure of half an acre as devastated by one sortie.

Carrying the argument a stage further,

The answer to "Howgozit?"

There's no guessing about gasoline on Clipper trips. Captains of Pan American's air giants use their famed "Howgozit Curve" to tell them, at every stage of the flight, if fuel consumption is satisfactory. The *planned* rate of consumption is charted on the "Howgozit Curve." Against this, ship's officers compare the *actual* rate in flight. Any deviation can be detected in time to adjust the flight plan.

That's one good example of Pan American's precautions to make every Clipper flight "routine"—and Pan American's use of Standard Aviation Gasoline is another.

Teamed with motors made to use it, high-octane Standard Aviation Gasoline has helped keep the "Howgozit Curves," running "according to plan," and enabled the plan to call for a 20% cut in Clipper fuel consumption. Through the first war year, its uniform dependability, its clean power helped Clippers hang up prodigious mileage and endurance records, helped Clipper pilots maintain far tougher schedules. Like Pan American, Standard Aviation Gasoline and Lubricants are building a war record that will help clinch America's sky leadership.

STANDARD OF CALIFORNIA

industrial figures tell us that in an average factory, 150 square feet of floor space is allocated to each workman. This criterion gives us an average of 290 workmen per industrial acre. But we know that factory floor space on the average covers only one-third of the area occupied by the whole factory, including roads, canteens and non-productive areas of all sorts. That means that we should reduce the figure to 96 men per industrial acre. Let us take only 90 men per acre to be on the safe side.

Examination of target areas suggests that in night bombing, using modern precision methods, the ratio of industrial to other property destroyed is one-third industrial and two-thirds general. Therefore, for every half-acre of devastation (the result of each sortie) one-sixth of an acre of industrial property is laid waste. At an average of 90 men per industrial acre that means that each sortie affects the work of 15 men.

Thus, on these figures we can estimate that each heavy night bomber carries at least 2.5 British tons of bombs and with them devastates half an acre of the target area which will involve the knocking out of the working space of 15 men as well as causing other damage to general property. The important point to determine is what this destruction costs in man-hours to the enemy.

This calculation needs some clear thinking and a good deal of research into German industrial methods. In practice, what happens is that the 15 men whose working space has been laid waste are either transferred to other factories or set to work on repairs. Meanwhile repairs to machine tools and replacement of buildings have to be undertaken. In fact we can divide the effect of the bombing into the following phases:

(a) Loss of factory output by direct damage and

(b) Loss of work from other causes.

(c) Cost of repairs to factories—reckoned in man hours, and

(d) Cost of repairs to other property—in man hours.

Study of German methods suggests that of the 15 men affected in the factory area, eight will be re-employed elsewhere immediately and the other seven put on repairs. The equivalent period of full time diversion in this manner would appear, from observed results, to be an average of three months.

Thus we find the total works out as follows:

(a) *Loss of factory output by direct damage.*

Loss of production of seven men for three months at 208 man-hours per month ..... = 4,368 man-hours

(b) *Loss of work from other causes.*

Loss of output through casualties, absenteeism, transport, dislocation, interruption of services, etc., by damage to property other than factories at 150 per cent of (a) (Ratio of areas affected) ..... = 6,560 man-hours

Therefore, the total loss of output per sortie is 10,928 man-hours—for statistical purposes, in round figures, *10,000 man-hours per night sortie.*

When we turn to the repair aspect, observations and building reports suggest that a figure of 50,000 man-hours per acre of buildings destroyed is certainly not too high. So on this basis we arrive at the following:

(c) *Cost of repairs to factories.*

One sortie destroys one-sixth (0.166) of an acre of industrial property of which 33.3 per cent. is built up. Therefore repair work is required to one-eighteenth (0.055) of an acre of buildings.

Therefore at 50,000 man-hours per acre the direct labor costs per night sortie ..... = 2,780 man-hours

To this must be added an equivalent for the labor costs of materials..... ..... = 2,780 man-hours.

And to this again a further equal amount representing the reconditioning and replacement of plant..... ..... = 2,780 man-hours

The gross labor costs thus work out at 8,340 man-hours per night sortie. This figure has been checked against known figures and is conservative.

But we must deduct from this the three months labor of the seven men diverted from production to repair. Thus we have: (8,340 — 4,368) = 3,972 man-hours.

In other words the net repair cost per night sortie is *3,972 man-hours.*

One further item remains to be computed. It is the cost of essential repairs to other property—naturally no unessential repairs will be undertaken. So we have:

(d) *Cost of repairs to other property (non-industrial).*

One night sortie affects one-third of an acre of non-industrial property of which, on an average, one-third is built up area. Therefore, each sortie involves damage to one-ninth (0.111) of an acre of non-industrial buildings. Repair and demolition work to this sort of property can be fairly estimated at 40,000 man-hours per acre. Therefore at 40,000 man-hours per acre the direct labor cost per sortie ..... = 4,444 man-hours

To this must be added 50 per cent for labor costs of materials and replacements..... = 2,222 man-hours

Thus the total repair costs to non-industrial property per night sortie amount to ..... = 6,666 man-hours

On this basis the total repair costs to all property per sortie = (3,972 + 6,666) = 10,638 man-hours—in round figures a further 10,000 man-hours per sortie.

From this we see that the total results per night sortie can be mathematically computed as follows:

Loss of output..... = 10,000 man-hours
Extra work caused.. = 10,000 man-hours
Total per night sortie = 20,000 man-hours

In other words 20,000 man-hours of destruction is caused to the enemy for every 2.5 (British) tons of bombs dropped at night; 8,000 man-hours per ton. Cross checks by other methods and from other sources confirm these estimates as conservative for the average results of night bombing at this writing. [Early in July.—Ed.]

What we want to know is:

(1) The profit and loss account for damage done compared with losses incurred in doing it, and

(2) How the damage measures up when set against the enemy's total productive force.

First of all, then, let us set the 20,000 man-hours of damage per sortie against the cost to the Allies per heavy night bomber sortie. Even if we reckon a casualty rate of five per cent for the bombers—and all the indications are that the losses are less than this amount—that means that, on an average, each bomber has an operational life of 20 raids. Incidentally it does not mean that after 20 raids any particular bomber will not return. It merely means that on each raid, however many sorties that bomber has made already, the odds are 19 to 1 in favor of its return. Those odds will not vary for any individual machine so long as the casualty rate does not increase. At present [as of July.—Ed.] the rate is going down.

Basing our estimates on a five per cent loss the cost per sortie in man-hours may be worked out as follows:

Bomb production and transport (2.5 tons) .....100 man-hours
Fuel production and transport (900 gallons) .....150 man-hours
Amortization of crew (1/20 of training period for eight men).....800 man-hours
Amortization of heavy bomber (1/20 of production time of 70,000 man-hours) ..... 3,500 man-hours
Servicing, repairs, etc. (Work of ground crews of 50 per sortie)..450 man-hours
Total cost per heavy night bomber sortie .....= 5,000 man-hours

The profit and loss account then reads:

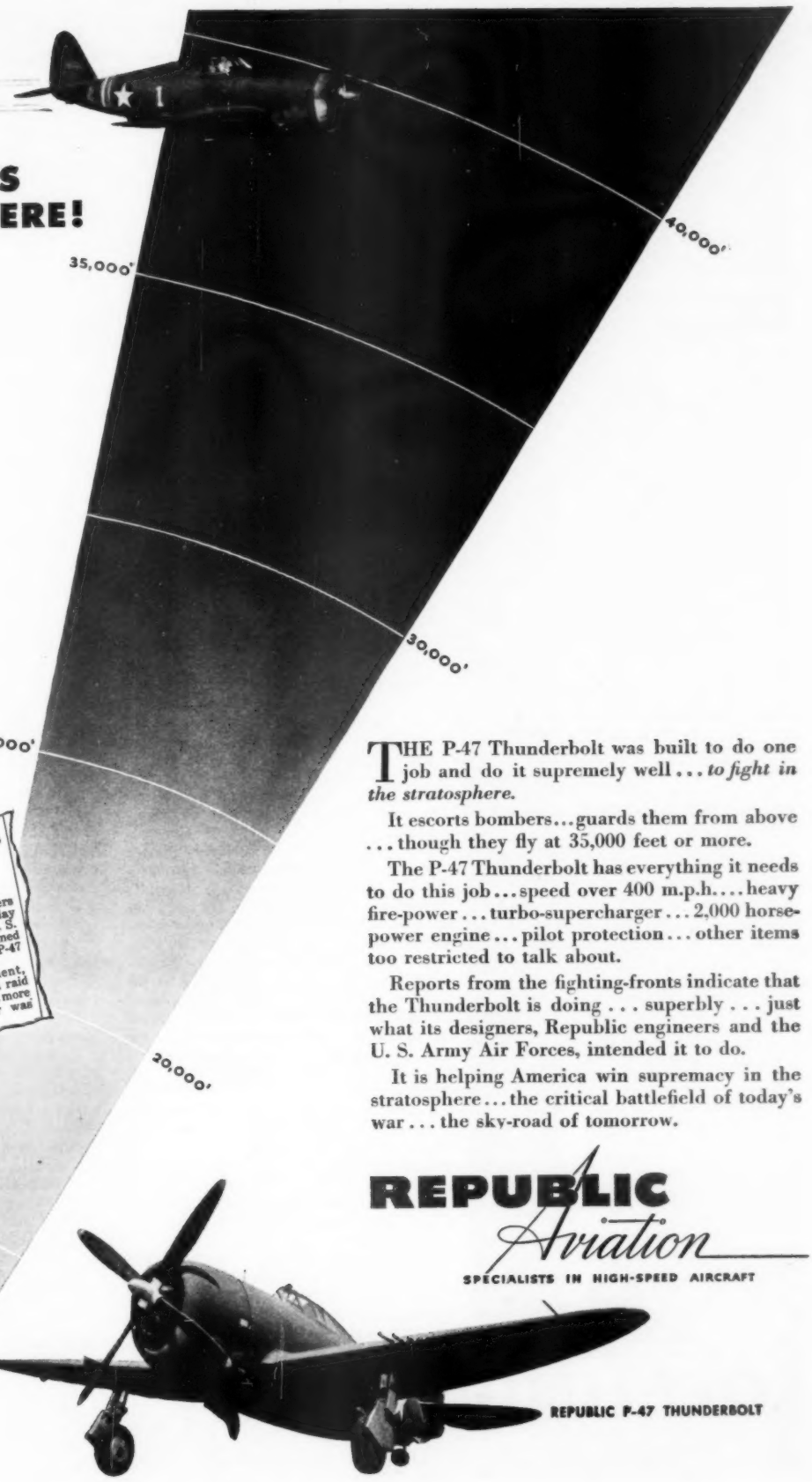
Destruction caused in Germany per heavy night bomber sortie..... .....20,000 man-hours
Cost per sortie in achieving this destruction .....5,000 man-hours

The gain per sortie is thus 15,000 man-hours—a ratio of four to one in favor of the night bomber. A 2,000-ton (800 bomber) raid may be estimated as causing 16 million man-hours of damage to Germany and costing four million man-hours to the Allies. In an operating life of 20 sorties in, say, two months, each heavy night bomber robs the enemy of the work of 960 men.

The results of night bombing can be set out thus:

Destruction per ton (2,240 lb.)	8,000 man-hours
Destruction per sortie	20,000 man-hours
Destruction per bomber life	400,000 man-hours
Net gain per sortie..	
Net gain per bomber life	15,000 man-hours
Destruction in May, 1943 (12,500 tons dropped) 100,000,000	300,000 man-hours

The total quantity of work lost to the enemy by the scale of night attack in May, 1943,—100,000,000 man-hours—represents 20 per cent of the target figure of 500,000,000 man-hours per month, the destruction of which would cripple the



Republic P-47 Thunderbolts Cut Bomber Losses Over Europe

American high-altitude bombers are now being protected on day sweeps over Europe by the U. S. Army's fastest and heaviest-gunned single seat fighter... Republic P-47 Thunderbolt.

On their initial assignment, Thunderbolts returned from a raid over Belgium without a loss... more important, not one bomber was missing.

THE P-47 Thunderbolt was built to do one job and do it supremely well... *to fight in the stratosphere.*

It escorts bombers... guards them from above ... though they fly at 35,000 feet or more.

The P-47 Thunderbolt has everything it needs to do this job... speed over 400 m.p.h.... heavy fire-power... turbo-supercharger... 2,000 horsepower engine... pilot protection... other items too restricted to talk about.

Reports from the fighting-fronts indicate that the Thunderbolt is doing ... superbly ... just what its designers, Republic engineers and the U. S. Army Air Forces, intended it to do.

It is helping America win supremacy in the stratosphere... the critical battlefield of today's war... the sky-road of tomorrow.

REPUBLIC *Aviation*

SPECIALISTS IN HIGH-SPEED AIRCRAFT

REPUBLIC P-47 THUNDERBOLT

a new aeronautical technique!

ANYONE CAN SEE where this "hop-skip-and-jump" aircraft fits into the line-up of all those America is building *for specific wartime jobs.* Capable of practically vertical take-off and landing, the Autogiro can also hover, descend almost vertically for a better look, rise again and move slowly on, scanning every inch below . . .

America is proud that she has pioneers like G & A to develop such aircraft. For in this war today—and in the peace that will come—there's a place for every kind of air travel human ingenuity can concoct. Whether your future trips by air are transcontinental or week-end cross-country, your flight will be safer because of G & A's development and the thorough working-out of the aeronautical theories on which it is based.

YOU'LL BE SAFER on your Sunday driving flights tomorrow—or on week-end trips to Europe, Asia, Africa—because of other developments in aviation too. Here at Roebling, we've worked years to develop aircraft control cords to their present high point of perfection — but we haven't stopped there! For as each new plane has come along to fill new needs of this global war, Roebling has been ready with control cords to meet its new demands — and ready with new types of fittings and accessories, new methods of installation and maintenance, new *ideas* to make control cords function even more perfectly! *Aircord Division,* John A Roebling's Sons Company, Trenton, New Jersey. Branches and Warehouses in Principal Cities.

NAMES the U. S. must never forget

AERONCA
AIR CRUISERS
BEECH
BELL
BELLANCA
BOEING
BOWLUS
BREWSTER
CESSNA
COMMONWEALTH
CONSOLIDATED-VULTEE
CULVER
CURTISS-WRIGHT
DOUGLAS
FAIRCHILD
FLEETWINGS
FLETCHER
FORD
★ G & A AIRCRAFT
GENERAL MOTORS
GOODYEAR
GRUMMAN
HOWARD
INTERSTATE
LOCKHEED
MARTIN
McDONNELL
NORTH AMERICAN
NORTHROP
PIPER
REPUBLIC
RYAN
STEARMAN
TAYLORCRAFT
TIMM
VEGA
VOUGHT-SIKORSKY
WACO

* *In these frequent messages, Roebling salutes each member of the aircraft industry in turn.*

ROEBLING

means Control in the air

GERMAN WAR PRODUCTION

DIRECT LABOR FORCE ON WAR PRODUCTION	7 millions	
MAN HOURS PER MONTH ON WAR PRODUCTION (At 2,500 hours of work per man, per year; 208 hours per man per month)	1,460 million man hours	

ENEMY POPULATION

IN SERVICES	9½ million men	TOTAL 40 million. None of these are available to repair or replace lost output.
IN AGRICULTURE	11½ million men	
IN ESSENTIAL CIVIL INDUSTRIES	19 million men	
IN WAR PRODUCTION	7 million men	These must replace lost output and also repair damage.

BOMB DAMAGE DOES TWO THINGS

(1) Reduces War Production and Essential Civil Production by	(a) Direct damage to factory area.	All of which must ultimately come out of the 7 million war production works.
	(b) Loss of output through dislocation of transport, absenteeism, casualties, etc.	
(2) Increasing the load on the Economic machinery by	(a) Diversion of man hours to repairs.	

German war machine completely. In other words so long as the May scale of attack is maintained the enemy has to lay off 480,000 men permanently from war production or essential civil industries in order to fight the enormous effects of the bomber offensive. And this is achieved with a bomber force in the air of some 40,000 men and for a loss of 2,000 men during the month. We would have suffered many times that loss figure to cause half the damage by any other means.

When we add the rapidly growing results of the American daylight offensive the figure really begins to look impressive. By precision bombing on very carefully selected targets the effects of the day raids can cause widespread repercussions.

But this is not all. The bomber force, in addition to its effect on German production at large, ties down in defensive activities a great number of fighting men and workers who would otherwise be freed to assume an aggressive role. Further, the production of fighters for defense has been greatly expanded at the expense of bombers. The air and ground crews for these fighters, the observer corps, the flak and searchlight crews, the civil defense workers, the mine sweepers and the ship repair gangs all must be counted.

Add to them the labor and materials needed to maintain them and one finds that certainly not less than two million able-bodied Germans in all are taken away from serving on the Russian front or helping in the submarine campaign—all of them by the indirect results of Allied bombing.

We know, too, that the big raids have caused irreplaceable loss of housing and the problem has become so great that the enemy is having to build temporary barracks at great effort to house the workers close enough to their work. These temporary buildings burn very easily when they are hit. We know that Germany fears the bomber offensive even more than the Russian armies because Germany believes that a defensive line can be maintained in the east but can see no way of warding off the bombers.

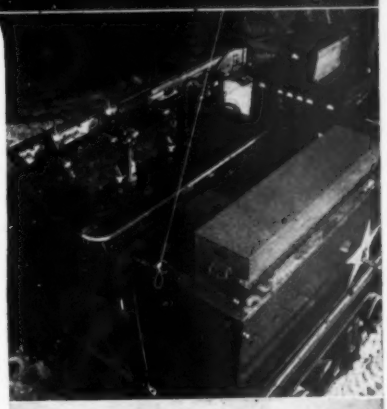
A doubling and trebling of the weight of Allied air attack by day and by night is coming inexorably and relentlessly. American production is still only at its beginning. British production of heavy bombs outstrips the losses and is increasing. Side by side, Air Chief Marshal Sir Arthur Harris and Maj. Gen. Ira Eaker are forging a doubled-edged weapon which is pounding down Germany's industrial war effort and is laying the vaunted "Fortress of Europe" wide open to final mopping up by Allied land forces —when all the strategic bombing will be turned to support the invading armies.

There is no other way of scoring so great a success at so small a price. Germany has taken upon herself the worst of all alternatives. She has accepted the most appalling casualties by becoming engaged in vast land campaigns on the eastern front and has thereby laid herself the more open to the effects of air bombardment in which the British and the Americans receive relatively few casualties for the maximum results. Thus there are spared to us great numbers of the best lives of the two nations. This will have disastrous results upon the enemy for generations to come.

We may expect that in the not far distant future the weight of daylight attack will rise to sorties of 1,000 bombers—perhaps 25,000 U.S. tons (22,000 British tons) per month—while the night attack reaches 25,000 British tons per month—that means both the Eighth Air Force and RAF Bomber Command operating 10,000 heavy bomber sorties per month—10 raids per month by day and by night by 1,000 bombers each. The area raids will be in "packets" of 1,000 flying to devastate one huge industrial area at a time, the precision raids by day in smaller "packets," each just sufficient to knock out one highly concentrated target.

The result of this will be perhaps 250 million man-hours of damage in all, allowing for the law of diminishing returns. When that happens German war production will be so far unequal to the demands upon it that the internal economy must fall into chaos. For Germany the "writing is in the air." END

Winning "THE BATTLE OF COMMUNICATIONS!"



Mobile communications units assembled by Hallicrafters are helping to win the battle of communications on every fighting front. They are built to endure the rigors of modern warfare . . . The consistent performance of SCR-299 has been highly praised by leading members of our armed forces for its adaptability in meeting all the requirements of combat duty . . . A phrase best describing the SCR-299 was given when a leading military authority said, "It is to communications what the jeep is to transportation."

BUY MORE BONDS!

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CHICAGO, U.S.A.

THE WORLD'S LARGEST EXCLUSIVE MANUFACTURERS OF SHORT WAVE RADIO COMMUNICATIONS EQUIPMENT

YOU CAN'T
SEE THEM
but
YOU KNOW
THEY'RE THERE

Like the stars on a cloudy night — you can't see the quality, service and dependability built into FLIGHTEX fabric but if it's FLIGHTEX fabric you know they're there.

No wonder each year more manufacturers buy more FLIGHTEX than any other airplane fabric.

World's Premier Airplane Fabric

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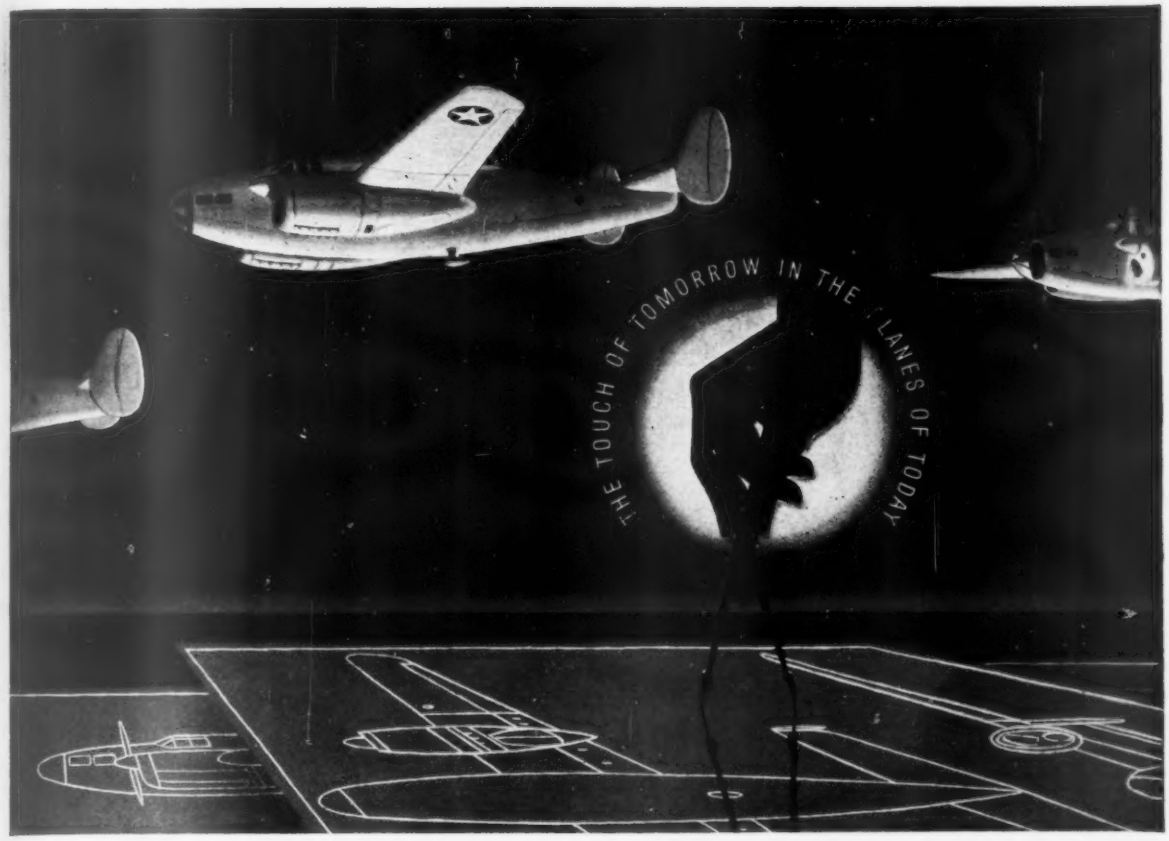

From Plans to Planes at Wartime Speed

Victory won't wait. It needs planes of all kinds at wartime speed. Day by day, the planes Fairchild is building are being produced 'just a little faster.'

When war broke out, Fairchild called in scores of sub-contractors in order to compress a month's ordinary production of parts into a day. A record for assembling the tools and putting men to work—as attested by the Army-Navy "E" flying over its plants today.

Production shortcuts clip minutes from hours . . . and put planes into pilot hands just that much sooner. No time to wait for a stretching die made of steel. Fairchild makes it of wood, saving much time, much steel. Special machines are designed for complicated forming operations once thought impossible to execute except by hand . . . and highly skilled mechanics are thereby freed to join the production battle at another spot. A machine is built that cuts down milling time on one part by 500 per cent. Still another machine is built which shapes a fitting so ingeniously that many hours-per-plane are saved in its installation.

And so it goes—a minute clipped here, an hour there. Time-saving ideas from Fairchild employees have helped put more than one additional pilot over Rabaul, Tunis, Hamburg.

Faster and faster roll the planes from Fairchild production lines. They must roll still faster . . . and they shall. For production, as well as performance, is behind "the touch of tomorrow in the planes of today."

"ON THE BEAM"

"The independence and liberty you possess are the work of joint councils and joint efforts, of common dangers, sufferings, and successes."

—Geo. Washington's Farewell Address

Buy U. S. War Bonds and Stamps!

Fairchild Aircraft *Division of Fairchild Engine and Airplane Corp., Hagerstown, Md.*

...and pioneering that created Havoc, Dauntless, Skymaster!

DOUGLAS stands for a lot of planes *designed for specific wartime jobs* — Army light bombers, Navy dive bombers, C-54 "flying Boxcars", old faithful DC transports. Douglas *was* building them or was *ready* to build them at the very moment of attack at Pearl Harbor! The C-54, biggest craft in quantity production anywhere, was coming off assembly lines a month after December 7, 1941! The A-20, fastest hit-and-run bomber in the world, was in service with the RAF by the hundreds long before! Navy Dauntless dive bombers had been tested, proved, accepted and *produced* in quantities to equip every flat-top in our Pacific Fleet! *Before* Pearl Harbor!

America can be thankful that she has organizations like Douglas Aircraft Company — that don't wait to be asked to look ahead! Before Pearl Harbor, biggest U. S. producer of commercial transport planes—Douglas went ahead to become a major producer of bombers and military transports as well, producing today *one-sixth* of the total tonnage of all aircraft built in U S! When Axis unconditional surrender comes, sky liners and flying freight trains will flow from Douglas assembly lines. Then, as now, America will say: "Douglas was ready!"

NAMES the U. S. must never forget

AERONCA
AIR CRUISERS
BEECH
BELL
BELLANCA
BOEING
BOWLUS
BREWSTER
CESSNA
COMMONWEALTH
CONSOLIDATED-VULTEE
CULVER
CURTISS-WRIGHT
★DOUGLAS
FAIRCHILD
FLEETWINGS
FLETCHER
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G & A AIRCRAFT
GENERAL MOTORS
GOODYEAR
GRUMMAN
HOWARD
INTERSTATE
LOCKHEED
MARTIN
McDONNELL
NORTH AMERICAN
NORTHROP
PIPER
REPUBLIC
RYAN
STEARMAN
TAYLORCRAFT
TIMM
VEGA
VOUGHT-SIKORSKY
WACO

ROEBLING WAS READY TOO!

HUNDREDS of other manufacturers had to be ready along with Douglas to write the story of accomplishment — with instruments, accessories, equipment, tools, supplies and parts! Here at Roebling we know what those others accomplished too, for Roebling had to be ready to supply thousands of America's new planes with control cord—every inch made to Roebling standards! *Aircord Division,* John A. Roebling's Sons Company, Trenton, N. J., Branches and Warehouses in Principal Cities.

*In these frequent messages, Roebling salutes each member of the aircraft industry in turn.

ROEBLING
means Control in the air

Planes Blaze Trail for Alaska Highway

(*Continued from page 56*)

naissance parties using pack horses would have taken weeks. However, it was accomplished in two days with the use of a seaplane.

Several exciting incidents occurred during the investigation. The journey started from Summit Lake, which is 4,200 feet in elevation, about 6,000 feet long, and from 200 to 400 feet wide for take-off, with hills or mountains rising in all directions. The plane was gassed-up. Provisions for several days and regulation Army tent weighing about 175 pounds were packed in the back end. We traveled approximately 3,000 feet before the plane was able to get up on the step of the pontoons. We continued for another 2,000 feet but were unable to lift clear of the water and the end of the lake was rapidly approaching.

It seemed to me that a crash was inevitable and my opinion was shared by the watchers from shore as they afterwards told us. However, the pilot cut the motors and we were able to come to a stop at the very end of the lake. Before making a second attempt all baggage was piled together with the passengers as far forward as possible. This time the plane was up on its step at 2,500 feet, clear of the water at 3,500, and the pilot, by giving it the gun, just cleared the ridge at the end of the lake—just a bit too close for comfort.

Although all the important terrain characteristics which were to be given primary consideration in the actual location of the route were discernible visually from the air, the need for speed, the heavy foliage, and the lack of facilities for detailed study during flights moved the authorities to decide that aerial photographs would be absolutely necessary.

A study of vegetation and soil characteristics show that certain types of soil support definite types of vegetation; for instance poplar and birch trees grow on dry ground; pine trees indicate sand or gravel formations; large spruce indicate fair ground, while small spruce and tamarack are found on muskeg. Willow, alder and buck bush usually mean wet ground. These different types of trees are easily identified from a plane.

A series of photographic strips were taken giving as complete a coverage as possible of all the area along the proposed route. These strips were taken to provide a 60 per cent overlap with each adjoining photo in the direction of flight. Each strip overlapped the adjoining one sufficiently for orientation.

A twin-engined Beechcraft monoplane fitted with a Fairchild aerial camera having a six-inch cone was used. The photographs were taken from an altitude of 7,500 feet above the ground wherever possible.

After a little experience it is quite simple to distinguish the different types of vegetation shown on aerial photographs when viewing stereo pairs with the aid of a stereoscope. The relief is quite apparent and differences in height can be measured readily with a parallax bar.

The various strips of photographs were examined using stereo pairs under a Fairchild prismatic stereoscope. Thus it was possible to establish certain points such as mountain passes, lakes, river crossings, swamps, rock ridges, etc., which govern the general location. The photographs were then assembled on a table and each photo carefully oriented with the adjoining one to form a mosaic of that area. A straight line was then drawn joining each successive control point.

The photographs were again examined under the stereoscope and, using the lines previously marked as a guide for direction, a continuous line was projected on each photo. This line would indicate the best route for the road location to follow in regard to grading, structures, missing swamps, rock ridges, alignment, etc. In other words, it represented the best location between the major control points.

We now had a set of photographs with a line marked on them showing where the road should be built. The next step was to transfer this projected line from the photographs and mark it in the field so that it could be easily followed by the men doing the construction. All lines were run by using a staff, prismatic or lensatic compass and marked by blazing or marking trees.

A single aerial photograph looks flattened and blurred. If a stereo pair is used and viewed stereoscopically all detail such as large trees, small openings in the bush, small creeks, etc. stand out sharply and clearly and are easily identified.

It is important, therefore, that the man in charge of transferring the line be capable of using stereo vision at will in the field without the aid of the stereoscope. For stereoscopic observations in the field it is desirable to dispense with equipment and view the photos directly. In order to accomplish this it is necessary to trick the physiological linkage between focus and convergence of the eyes; that is, to focus the eyes for about 12 inches and at the same time have them parallel or nearly so. This requires some effort of the imagination as well as accurate alignment of the photos.

To align the photos, they are placed so that they overlap with principal point bases in the same line. They are then slid along this line until corresponding detail points are about two inches apart. The photo then is held so that the principal point bases are parallel with the eye base about 12 inches from the eyes. The eyes are relaxed and the images blur.

It is found that at a certain stage a blurred stereoscopic image is seen. By an effort of will power this image may be brought into sharp focus. Once this condition is achieved the viewer is able to increase the separation to cover more

(*Continued on page 99*)

SUBMARINE BELOW---
FLASHES THE CIVIL AIR PATROL PLANE

The indistinct shadow beneath the water means little to the untrained eye—but, the C. A. P. Pilot and his Observer instantly recognize the outline of a lurking enemy submarine preparing for destruction and death. The Pilot's depth charge is soon on its way—the location radioed to the Army, Navy and Coast Guard. The destruction of the raider is imminent.

Former commercial and pleasure fliers who volunteered their services and their airplanes, the men of the Civil Air Patrol have been risking their lives daily since Pearl Harbor in the grim, relentless search for Axis submarines off our shores. Many ships have been saved from torpedoing—many already-shipwrecked seamen rescued—thanks to their ceaseless patrol. To them belongs no small share of the credit for driving the enemy undersea raiders away from our coasts.

We salute them for the courage, ability and self-sacrifice with which they do their job—and we are proud that many of the planes in which they perform this service to the Nation are Jacobs-powered.

JACOBS AIRCRAFT *Engines*

POTTSTOWN, PENNSYLVANIA, U. S. A.

"One newspaper in the country . . . and we selected The Washington Post"

—NATIONAL COTTON COUNCIL OF AMERICA

COTTON BOLTS... FASTER THAN ANY DIVE BOMBER!
LIFE HANGING BY THE STRONGEST THREADS!
EVERY U. S. Fighting Man Uses Cotton EVERY DAY
NATIONAL COTTON COUNCIL OF AMERICA
EVERY U. S. Fighting Man Uses Cotton EVERY DAY

THE National Cotton Council is publishing a series of 13 institutional advertisements to tell an important story about the job cotton is doing to help win the war.

To get this message across to our government The Washington Post was selected—the only newspaper in America being used.

There have always been a few publications which have been used by advertisers for their individual merits rather than as part of a list. A single magazine, for example, used by a company otherwise devoted solely to radio. A single newspaper, used by an advertiser otherwise in magazines only.

Today The Washington Post—outstanding newspaper of the Nation's Capital—is one of this handful of individual publications, to be considered as a unique medium, a solitary messenger peculiarly equipped to carry the story of your company to the creators of policy in Washington, D. C.

The Washington Post

Eugene Meyer, Editor & Publisher

Represented by Osborn, Scolaro, Meeker & Co., New York, Chicago, Detroit, St. Louis; by George S. Close, Inc., San Francisco, Seattle, Los Angeles; and by Metropolitan Sunday Newspapers for Sunday Comics Advertising.

Franklin First to Power a Transport Glider

It's getting to be a habit—this tendency of leading designers to specify Franklin power for their experimental planes. Among recent Franklin "firsts" have been the Sikorsky helicopter, the Northrup Flying Wing, the twin-engine Langley plastic-plywood ship and the new Piper PT-1 low-wing trainer. And now, latest in a long list, is America's first power glider, Northwestern Aeronautical's CG-4A cargo and troop transport, equipped with two Franklin engines.

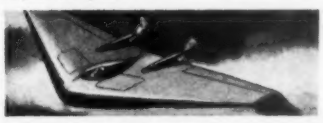
Still more revolutionary Franklin "firsts" are in the making at the Aircooled Motors plant. They are new, more powerful engines designed by Franklin engineers for special wartime aviation duties.

Standardize on Franklin power for your post-war ships. Get the same reliability and engineering excellence which has made Franklins first choice for so many of aviation's new developments. In any Franklin—from 65 H.P. to 500 H.P.—you get the benefit of 43 years' experience in producing fine air-cooled engines.

AMONG Franklin FIRSTS

FIRST to power a twin-engine light plane, the plastic-plywood Langley.

FIRST to power the successful Sikorsky helicopter.



FIRST to power the experimental Northrup Flying Wing.

AIRCOOLED MOTORS CORP. ★ SYRACUSE, N. Y.

Full Speed Ahead

AMERICA'S Victory fleets of aircraft, ships and tanks are on their way, roaring full speed ahead in the vanguard of invasion toward the goal for which we all are fighting. Serving aboard these battle units of land, sea, and air is the vitally important equipment that Breeze is producing today in constantly increasing quantities. Such products as Breeze Radio Ignition Shielding, Multiple Electrical Connectors, Flexible Conduit and Fittings, Aircraft Armor Plate and Cartridge-Type Engine Starters are but a few of the many items in the Breeze line that are playing their part on fighting fronts the world over. Performing dependably under the grueling conditions of modern warfare, all Breeze products possess the built-in quality that reflects a background of many years of Breeze engineering and production experience.

BREEZE CORPORATIONS, INC., NEWARK, N. J.

Breeze BREEZE MARK

(*Continued from page* 94)

of the overlap. The more the photos are spread the greater is the relief. Only about one-half the overlap can be observed at one time. In order to see the other half, the photos are overlapped the opposite way.

In an accompanying photograph, the line marked "proposed center line of highway" is the selected route for the location of the highway. The task is to run this line in the field, and mark it by blazes on trees so it may be readily followed for construction purposes.

The first requirement is to determine the magnetic azimuth or bearings of the lines. To do this, one must carefully orient the photograph. Point "A" on the photograph is a well-defined point at a bend in the river which can be established exactly in the field. Starting at point "A" on the ground a line is run in the general direction of the river for a sufficient distance to give a suitable base line to mark on the photograph. In this case it was run to point "B," where the line happened to come close to the edge of the river and could be definitely identified on the photo.

The bearing of this line was observed to be north 10° 30′ west. A straight line joining these two points, namely "A" and "B," was drawn on the photograph. A line joining these two points intersects one of the tangents marking the proposed center line at "C," and if the other two tangents are produced they will intersect at "D" and "E." By using a protractor at "C," one reads that the base line makes a measured angle of 52° 00′ with the line marking the center line of the proposed highway, and its bearing is calculated to be north 62° 30′ west.

In a similar manner the bearings of the two other center line tangents are calculated to be south 64° 00′ west and north 89° 00′ west. The deflection angles at "F" and "H" are also read with a protractor, measuring 53° 30′ and 26° 30′, thereby checking the bearings with each other.

The next operation is to set up the staff compass at some point on one of the tangents to be established. An ideal place, for example, would be on the edge of the river which one of the lines crosses. This is the easiest and most definite point to establish.

By setting the compass to read north 62° 30′ west, this course is run and marked by blazing trees a distance of 1,875 feet, derived from scaling the distance on the photograph from the edge of the river to "H," which is the point of intersection of the next tangent. The measured distance is used only to facilitate and check the orientation of "H" from the aerial photograph. When the officer in charge is satisfied that he is at the exact point as marked on the photograph the new bearing of north 89° 00′ west is laid off and the line continued on the next tangent.

The officer keeps a close check at all times to make sure that the line being run does not deviate from the projected line. Quite often when the line does not cross any well-defined object that can be identified on the photograph, it will be necessary to check the line by measurements from edges of clearings, swamps, large trees, gulleys, rock ledges, etc., that are close or adjacent to the line and can be identified on the photo.

If the line does start to vary a correction is made at the next point of intersection of tangents. If the variation is too great the line is re-run on the corrected location. Each succeeding tangent is run in the same manner through any number of photographs except for establishing new base lines. Every course is a base line in itself, so long as it is established in the field exactly as it is marked on the aerial photograph.

With the adoption by the Army engineers of this new method of locating, it was found that an average of four miles of line per day could easily be located. Construction workers were never again held up for lack of location.

After a period of four weeks spent in the field, I was ordered to proceed to Fort Nelson with the photographic plane, pilot and photographer to take additional photographs. We had been living on Army rations which consisted of dehydrated potatoes, onions, canned "C" rations, powdered eggs and milk. It was certainly a pleasant surprise to find that for dinner at the airport we were served iceberg lettuce, fresh tomatoes, cucumber, berries and new potatoes (the latter costing $21 per bag). All these supplies had been flown in from Edmonton, 700 miles to the south. At that time there were a considerable number of forest fires burning in the district and the direction of the wind kept the smoke blowing over the area which we were to photograph, grounding us for three days. The fourth day the wind changed and we were able to take off. In six hours an area of 1,300 square miles was photographed.

While returning to Fort St. John in the seaplane, flying at about 1,000 feet, we encountered a squall. Dust was rising from the wheels of the trucks as they proceeded along the finished highway below us. Suddenly what appeared to be a spiral of dust about 150 feet in diameter formed in the road ahead of us.

I was in the back end by the door, sitting on the mooring ropes, emergency rations and boxes. The first sensation was similar to that of being dropped 10 floors in an elevator. My stomach seemed to drop to my ankles. The next instant my body was trying to push my head through the roof.

Every object which was not fastened to the aircraft seemed to become attached to the roof of the plane. This lasted for one or two seconds, when we were brought back to the floor of the plane with a jolt. All this happened in the space of four or five seconds. When the plane was righted we were only about 100 feet above the trees. We had been blown in every direction and from the bumps it seemed as if we had traveled as much vertically as horizontally.

But, like our trip up the mountain pass, no real damage was done. We completed the aerial reconnaissance in good time and the road was located on the basis of our findings. END

For teaching pilots "how to get there!"

TAKE A LOOK at the trainers Howard Aircraft is building for Army and Navy. "Just" trainers—but mighty important cogs in the machine of air power. In the little low-wing PT-23, future Army aces get their first feel of flying. In the 4-place NH1, Navy fliers receive training in instrument flying—and when a flat-top's on radio silence, you just try and find her *without* instruments! These planes may be unsung as far as the general public is concerned, but to the men who fly them—and learn the lessons that will *keep* them flying safely—they are not without honor, and plenty of it!

America can be proud that she numbers among her aviation manufacturers some like Howard who can turn out "just" trainers of all the kinds our fighting air forces need. Proud—and pleased at the prospect these planes offer for after-Victory sky flivvers to give everyone the pleasure and convenience of doing his own flying. The future of aviation to some may lie only in bigger and faster and longer-range planes—but to the average man it will always lie in the planes he can fly himself or look forward to flying and buying!

ONE OF THE things you're going to be buying, in that plane you'll fly yourself, is control cord. You may never even *see* it . . . take it for granted as we do parts of our cars today. You'll be able to do that, *safely* because we at Roebling take nothing for granted in making that control cord the finest, strongest, most durable cord that our 100 years of wire rope engineering gives us know-how to do—in war or peace! *Aircord Division,* John A. Roebling's Sons Company, Trenton, New Jersey. Branches and Warehouses in Principal Cities.

NAMES the U. S. must never forget

AERONCA
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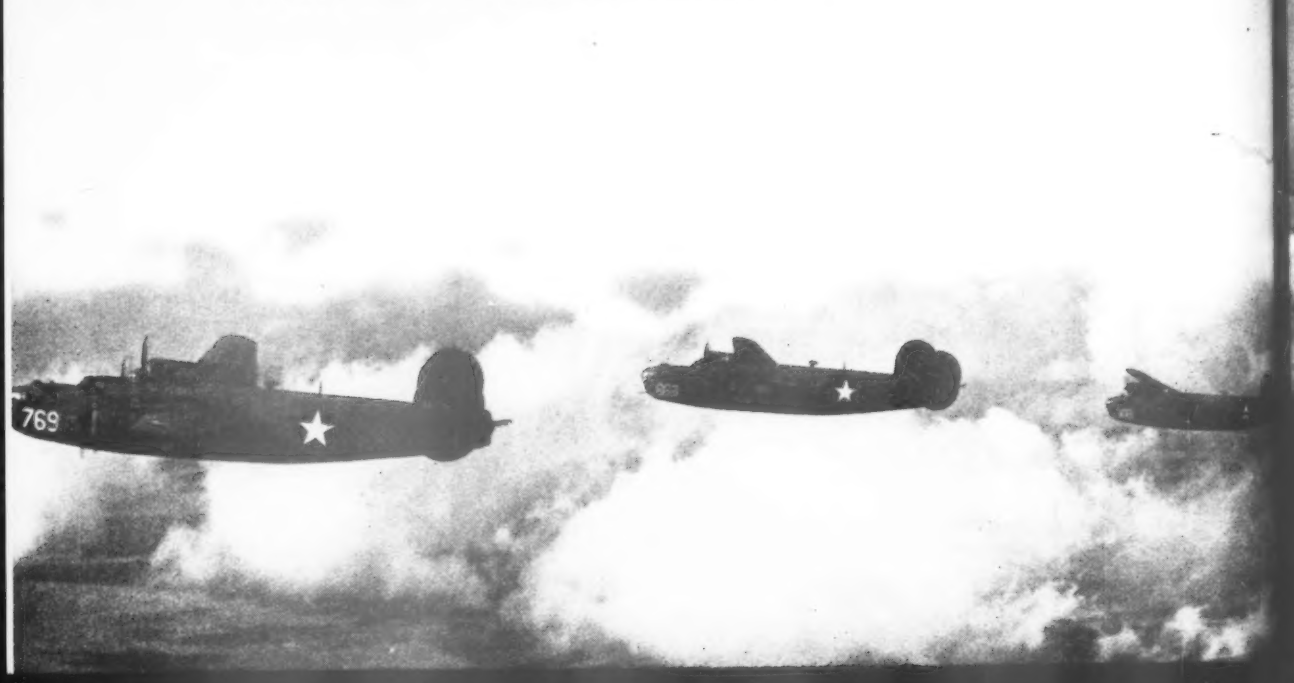

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Army Air Forces map showing flying time from Washington to principal war theatres of the world. Prepared especially for this issue by the Army Air Forces.

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An air umbrella should be able to attain great altitude. In addition, its planes must have fuel enough to patrol vast areas of hostile ocean. That these aircraft are able to meet both requirements is due in important measure to the lightness of Boots all-metal, self-locking nuts. Because Boots Nuts are lighter than other nuts, the weight they save can be utilized for extra gasoline—or ammunition.

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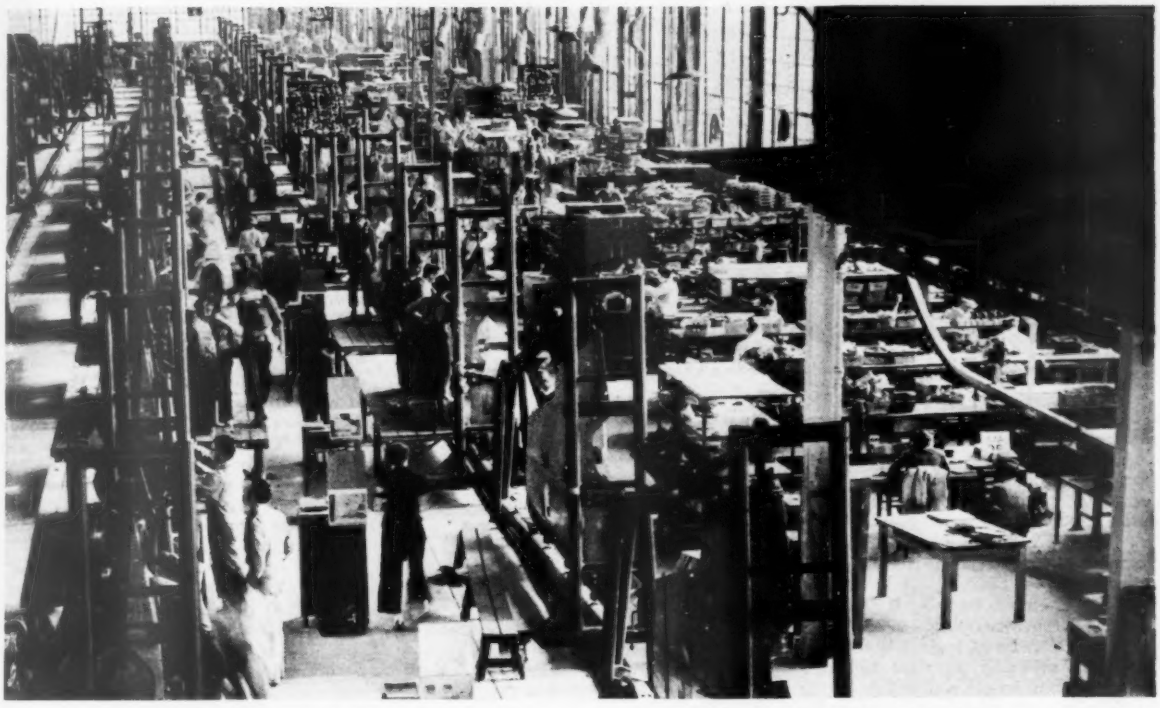


Airacobra wings take shape on these parallel, conveyorized assembly lines at Bell Aircraft Corporation.

AIRACOBRA WINGS

By turning the fabrication of Airacobra wings into a line-run job from start to finish, Bell Aircraft has broken another bottleneck in aircraft volume production.

by JOHN E. RAE

Superintendent, Wing Assembly,
Bell Aircraft Corporation

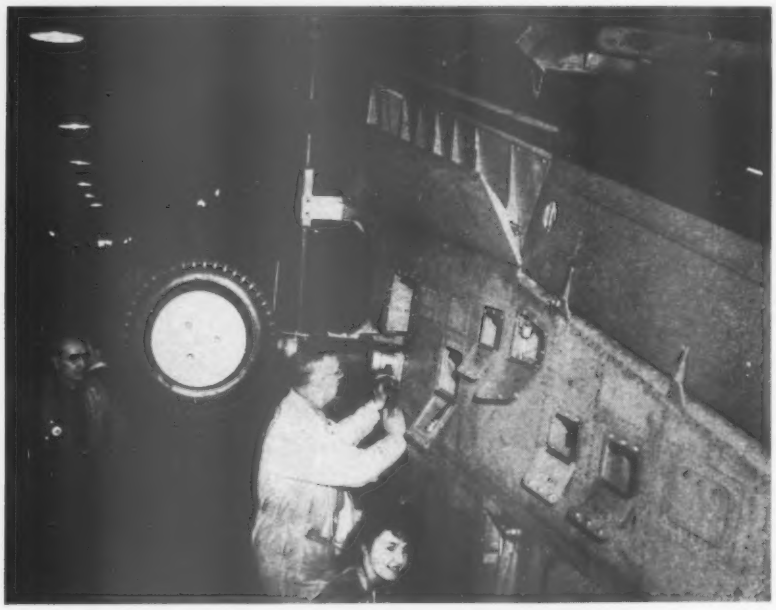
SEVERAL months ago Bell Aircraft Corporation, a leader in the introduction of constantly-moving assembly lines in the aircraft industry, pioneered a new advancement—constantly-moving production lines for wing panels. The new operation includes not only assembly but also fabrication on the lines for Army P-39 *Airacobras*.

Since the initial successful operation of these lines, the company has gone a step further, extending the conveyor system through the paint shop directly to the shipping rooms.

As the panels come off the conveyor lines, they are loaded into trucks for delivery to Bell Aircraft's assembly plant, where the panels are attached to the completed fuselage.

Until very recently the aircraft industry assembled wing panels by assigning a crew of men to the job. The process was long and drawn out, and only experienced assemblers could do the work. Considering the fact that about 1,400 operations are necessary to complete a single panel, the amount of experience required of such assemblers is easily appreciated. Their knowledge had to extend from the spar which forms the backbone of the panel to the last rivet in the skin.

On the constant-motion assembly line we are using inexperienced women for 85 per cent of the actual work done, performing the hundreds of operations, into which the overall job has been divided. Few operations require heavy lifting, and only for these few jobs are men utilized on the lines themselves. They form about five per cent of the department's personnel. The other 10 per cent of the jobs filled by men are principally top supervision. The day may not be far off when the working personnel on the wing lines



An inspector examines the retractable landing gear mechanism installation.

will be 100 per cent women, thereby releasing more men to other important war work.

In the breakdown of the wing panel assembly job, each individual task is comparatively simple and easy to learn. But, the jobs had to be learned for the most part by women who never before had worked in a factory. We have hundreds of housewives on the job. To teach them the proper handling of tools and shop practice we have devised an instruction system whereby we send each new hire to a public school course for a week and then bring her into our factory and let her operate tools in practice assembly in a "vestibule" school within our own plant. Here she is given a week to get the feel of things in actual practice, and then she is placed on the line. During all this training period new employes are paid the starting rate of pay enjoyed by the others.

Until she becomes expert the new employe wears a "T" button, which sets her off as a trainee not fully skilled in her job. Specially trained supervisors keep a close eye on the wearers of "T" buttons, offering friendly assistance and instruction.

Even after the new employe graduates from the trainee class, she still has constantly-available instruction as to the proper way to perform any operation. Each station has a complete list of photographs of each operation performed at that station. The photographs, outlined with detail instruction and easily read, are available to all workers, and tell the proper sequence of operations, as well as the correct performance of all the various operations.

Our wing assembly department is broken up into three major divisions: Bench assembly, subassembly and final assembly. The bench workers, all of whom are women, prepare smaller parts for subassembly and also do such operations as dimpling and countersinking. Among the many other jobs performed on the benches are the assembly of bulkheads, wheel wells, cowlings and gas tank covers.

The subassembly division comprises two main sections, one in which the trailing edge and auxiliary beam are assembled, and in the other, the front and rear beams, leading edge and spindle bearing. Bench and sub-assembly work are laid out parallel to the conveyor lines and synchronized to the forward motion of the power-operated lines.

We have several constant-motion production lines and one constant-motion combination feed and return line—each of which is many hundred feet long. The panels are built in combination fixture-dollies. The dollies start on the line stripped, and roll off the end of the line carrying a completed wing panel ready to be attached to the fuselage.

All lines run parallel. On each of the forward lines identical work is performed, and when a dolly has traversed anyone of the lines it is a completed unit.

The feed line travels at a rate equal to the combined rate of the other lines and supplies them with fixtures. Left and right hand panels are started on the feed line alternately, but only right hand panels are fabricated on some lines and only left hand panels on the others.

(*Continued on page* 114)

Overhead attachments keep the floors clear of tools.

This dolly returns empty fixtures, receives new parts.

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Style "O" Material Handling Container No. 425F11
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No. 2401-11
28" deep, $2.95
No. 2401-12
34" deep, $3.30

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Bottom tray and 3 stationary shelves provide 1260 square inches of shelf area under lock. (Padlock attachment—padlock not furnished.) 21-1/4" W. x 15-1/4" D. x 34" H. $12.00.

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Production Illustrations

Part II—Additional uses for three-dimensional drawings in the aircraft industry are described.

by A. D. PYEATT

Supervisor, Production Illustration
Douglas Aircraft Co., El Segundo Plant

THE first half of this article, which appeared in the August issue of FLYING, described the organization and functions of a Production Illustration Group in preparing three-dimensional drawings to be used in every phase of production. Examples were shown of the use of production illustrations in (1) request for bids, (2) production breakdown (exploded view) and (3) preliminary equipment location. The conclusion of the article, which follows, explains the use of these illustrations in portraying structures, systems, engineering installations, jobs, subassemblies, outside vendor items and miscellaneous manufacturing operations:

B. Production Design—*1. General:* Production design starts after basic layouts have been frozen and the airplane is to be designed in detail for production by the engineering department. It is here that the design groups make production engineering orthographic drawings. These drawings go into extreme detail on such items as material, sub-structural assemblies, main assemblies, and complete functional installations. Scheduling, tooling and planning as well as production control, material procurement and time standards become involved. They are all interested in what engineering is going to release.

The following types of illustrations are made to accelerate the design and nonproductive functions by creating a preview of engineering production design for all departments concerned.

2. Structures: Illustrations are made of each structural sub-assembly as designated by the production breakdown. These illustrations are designed to explain the important factors of the structure such as the general type of structure, mechanical complexities, important fittings, etc.

3. Systems: The usual engineering orthographics, due to the scope, have several sub-installation drawings involving the total system and never show the complete system on one drawing. The system illustrations, or functional installations, are made and shown as separate complete systems per illustration with all attaching structure and components plainly illustrated.

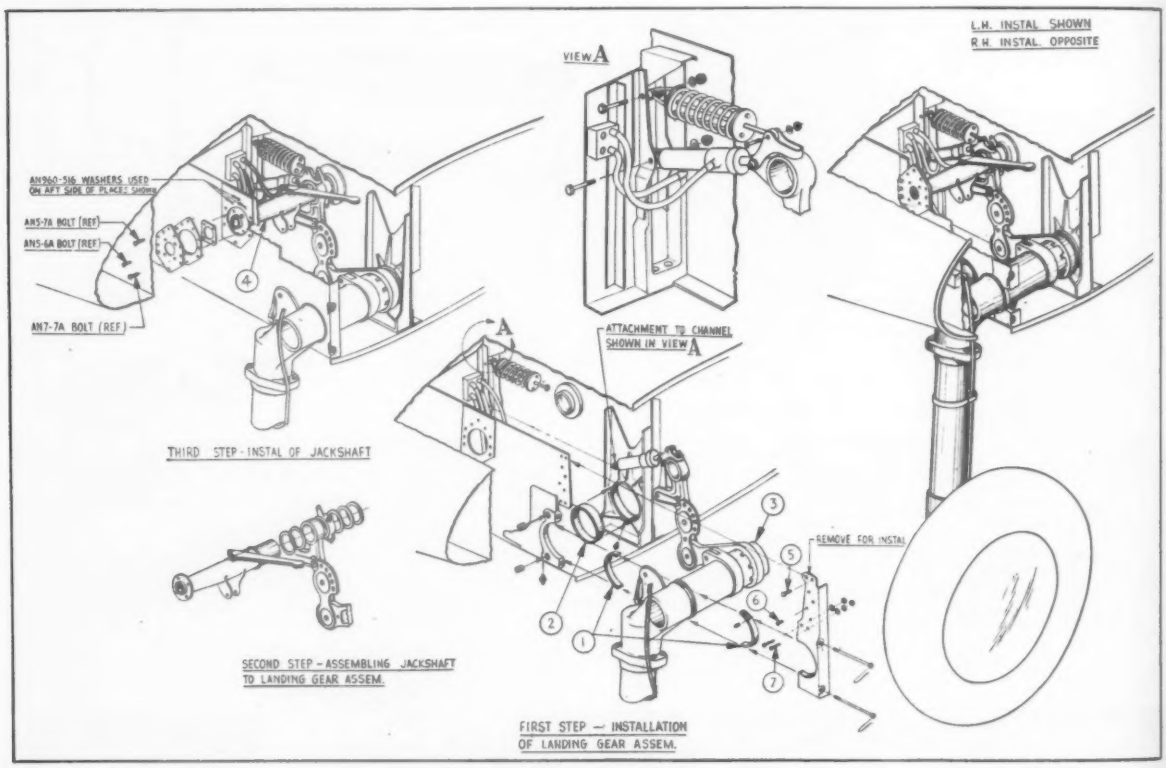

L.H. INSTAL. SHOWN
R.H. INSTAL. OPPOSITE
VIEW A
AN960-516 WASHERS USED ON AFT SIDE OF PLACES SHOWN
AN5-7A BOLT (REF)
AN5-6A BOLT (REF)
AN7-7A BOLT (REF)
ATTACHMENT TO CHANNEL SHOWN IN VIEW A
REMOVE FOR INSTAL
THIRD STEP - INSTAL OF JACKSHAFT
SECOND STEP - ASSEMBLING JACKSHAFT TO LANDING GEAR ASSEM.
FIRST STEP — INSTALLATION OF LANDING GEAR ASSEM.

Fig. 5. Job Illustration

Item No.	Item	No. Req.
1. 2068579	Bearing, front	1
5061801-5	Pin	1
1061424	Trunnion nut	2
1061423	Bolt	2
AC995-47-3	Lockwire	2
AN286-1	Lubricator	1
2. 288987	Bearing, rear	1
AC286-1	Lubricator	1
3. 5059999-408	Landing gear assem. l.h.	1 (L)
5059999-409	Landing gear assem. r.h.	1 (R)
4. 5059999-402	Jackshaft and link l.h.	1 (L)
5059999-403	Jackshaft and link r.h.	1 (R)
S-143908-208	Washer	5

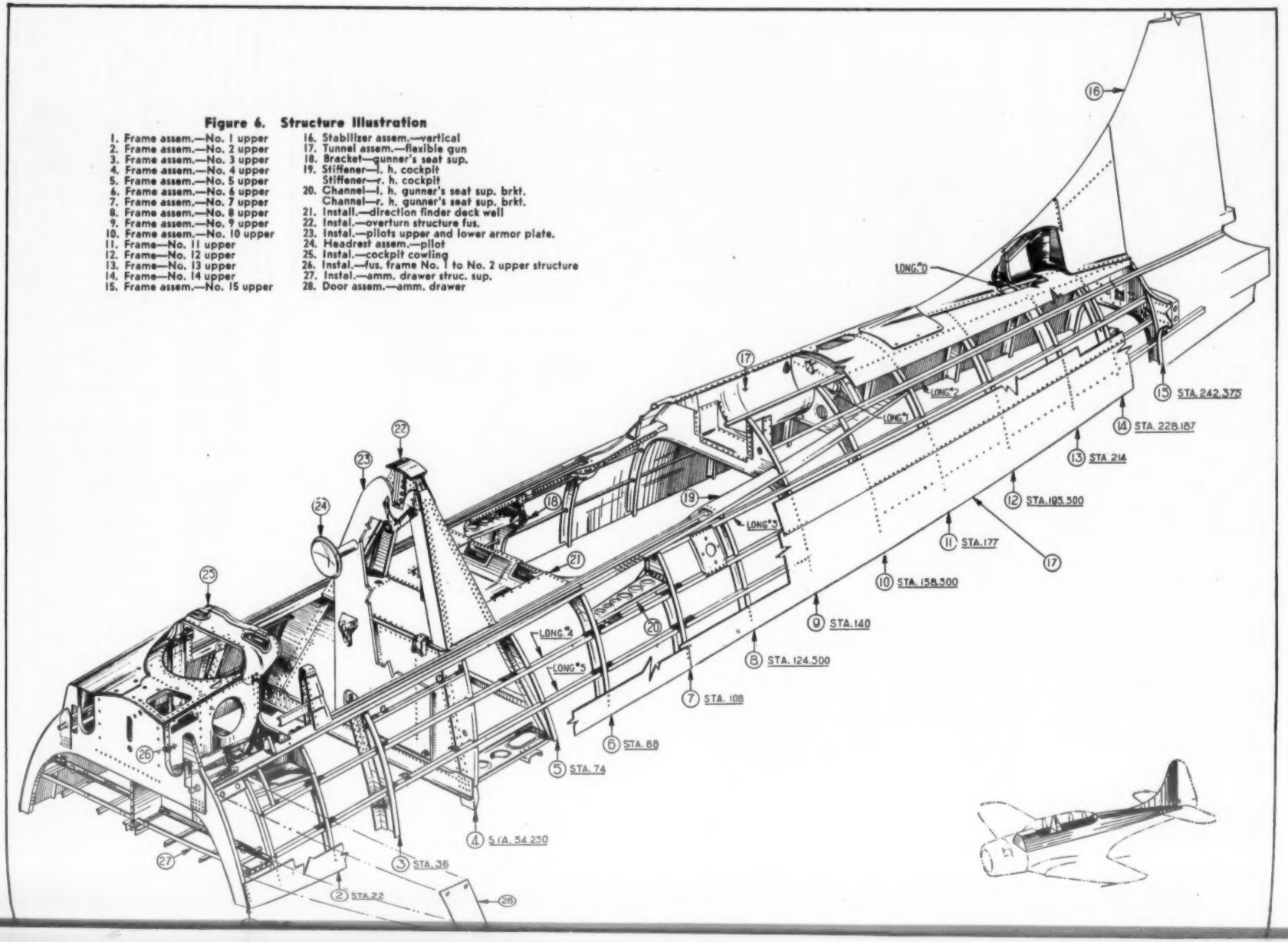
Item No.	Item	No. Req.
S-224-022	Shim	1
1091901	Shim	1
2091336	Bolt	2
AN7-7A	Nut	2
AC365-720	Bolt	9
AN5-6A	Bolt	1
AN5-7A	Washer	3
AN960-516	Washer	7
AN960-516L	Nut	10
AC365-524	Bolt	2
5. AN5-7A	Nut	2
AC365-524	Washer	2
AN960-D516	Screw	4

Item No.	Item	No. Req.
6. AC525-416-11	Washer	4
AN960-D416	Nut	4
AC365-428	Screw	2
7. AC-525-416-20	Washer	1
AN960-D416	Washer	2
AN960-A416	Nut	2
AC365-428		

NOTE:
1. Parts marked thus (L) used on L.H. instal. only.
2. Parts marked thus (R) used on R.H. instal. only.

Figure 6. Structure Illustration

1. Frame assem.—No. 1 upper
2. Frame assem.—No. 2 upper
3. Frame assem.—No. 3 upper
4. Frame assem.—No. 4 upper
5. Frame assem.—No. 5 upper
6. Frame assem.—No. 6 upper
7. Frame assem.—No. 7 upper
8. Frame assem.—No. 8 upper
9. Frame assem.—No. 9 upper
10. Frame assem.—No. 10 upper
11. Frame—No. 11 upper
12. Frame—No. 12 upper
13. Frame—No. 13 upper
14. Frame—No. 14 upper
15. Frame assem.—No. 15 upper
16. Stabilizer assem.—vertical
17. Tunnel assem.—flexible gun
18. Bracket—gunner's seat sup.
19. Stiffener—l. h. cockpit
    Stiffener—r. h. cockpit
20. Channel—l. h. gunner's seat sup. brkt.
    Channel—r. h. gunner's seat sup. brkt.
21. Install.—direction finder deck well
22. Instal.—overturn structure fus.
23. Instal.—pilots upper and lower armor plate.
24. Headrest assem.—pilot
25. Instal.—cockpit cowling
26. Instal.—fus. frame No. 1 to No. 2 upper structure
27. Instal.—amm. drawer struc. sup.
28. Door assem.—amm. drawer



4. Engineering Installations: It is a regular engineering demand at this time that most functional installations are made by the production illustration group. These illustrations include complete dimensional material and installation details. Orthographic is seldom resorted to on these illustrations.

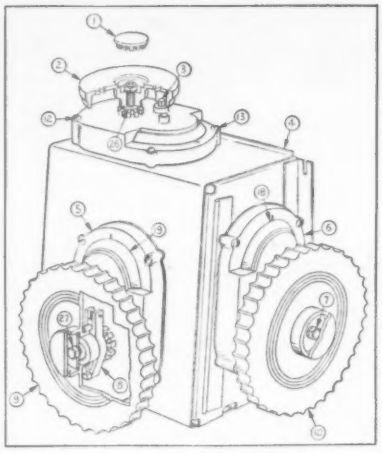
5. Miscellaneous: During the entire engineering program many engineering groups find the use of three-dimensional presentation advisable. Proposals are often required in this manner. Design sketches are often required by the various design groups. These illustrations are classified as miscellaneous engineering illustrations.

3. Manufacturing Functions—

A. General: Analysis of the manufacturing departments disclosed that 80 per cent of the shop time was involved in assembly work and only 20 per cent for fabrication. With this in mind, the manufacturing illustrations are designed mainly for assembly and not fabrication.

Working from engineering orthographic drawings, which are the authority in the plant, the production planners must assure good job breakdown, assembly sequence and installation feasibility on the new airplane for the shop. These men use the engineering phase illustrations to assist them in making these breakdowns; but they are without a picture of the job breakdowns as they have listed them. Therefore, the use of advance illustrations of these jobs as they are planned usually result in many changes before the shop gets involved. This is the cheap way to change—on paper, not involving men, materials and production. Therefore, a complete advance set of manufacturing illustrations is usually requested by the planning department to confirm their breakdown decisions.

This accelerated program of manufacturing illustrations also makes available



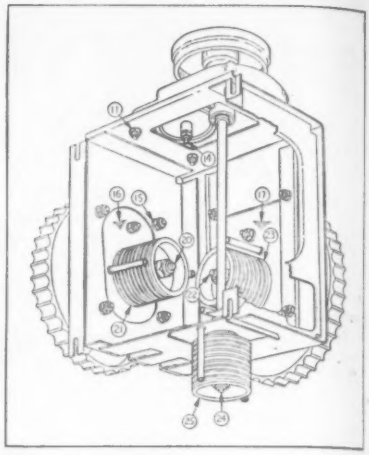


Figure 7. Subassembly Trim Tab Control Box

Item No.		No. Req.
1.	No. 50726 ..... Plug Button	3
2.	4152637 ..... Knob Assem.	1
3.	1152880 ..... Pin	3
	1152881 ..... Spring	3
4.	5153645 ..... Box Assem.	1
5.	4152547-4 ..... Housing Assem.	2
6.	4152547-6 ..... Housing Assem.	1
7.	AN4-4A ..... Bolt	1
	AN936-A416 ..... Washer	1
	S-124682-4S16.065 ..... Washer	1
8.	2155058 ..... Lever Assem.	1
9.	4152605-4 ..... Wheel Assem.	1
10.	4152605-2 ..... Wheel Assem.	1
11.	AC364-1032 ..... Nut	15
12.	AN23-24A ..... Bolt	6
13.	AN23-16A ..... Bolt	6
14.	AN23-26A ..... Bolt	3
	AC364-1032 ..... Nut	(Ref.)
	AN960-10 ..... Washer	(Ref.)
	1152879 ..... Spacer	3
	2153769 ..... Cam	1
15.	AN960-10 ..... Washer	15
16.	2153709-4 ..... Plate Assem.	1
17.	2153709-6 ..... Plate Assem.	1
18.	2153770 ..... Cam	1
19.	2153708 ..... Cam	1
20.	1152872 ..... Shaft	1
	1152871-4 ..... Bearing	1
	1152871-2 ..... Bearing	1
	AC364-624 ..... Nut	1
	AN960-616 ..... Washer	1
21.	4154115-8 ..... Drum Assem.	1
22.	1152872 ..... Shaft	1
	1152871-4 ..... Bearing	1
	1152871-2 ..... Bearing	1
	AC364-624 ..... Nut	1
	AN960-616 ..... Washer	1
23.	4154115-12 ..... Drum Assem.	1
24.	2153710 ..... Shaft Assem.	1
	1152871-2 ..... Bearing	2
	AC364-624 ..... Nut	2
	AN960-616 ..... Washer	2
25.	4154115-10 ..... Drum Assem.	1
26.	1152871-2 ..... Bearing	(Ref.)
27.	AN4-4A ..... Bolt	1
	AN936-A416 ..... Washer	1
	S-124682-4S16.065 ..... Washer	1

a complete set of illustrations for the shop before the assembly line is started. The following manufacturing illustrations are usually made for the shop, totaling approximately 400 per model.

B. Job Illustrations: Job illustrations show in detail the parts involved and operations necessary to assemble each component part of a group of functional unrelated jobs in an airplane section on the assembly line or a group of functional related jobs in a section or a single elapsed time job. Illustrations are used by the mechanics in the shop for the actual assembly and fabrication of parts.

(*Continued on page* 114)

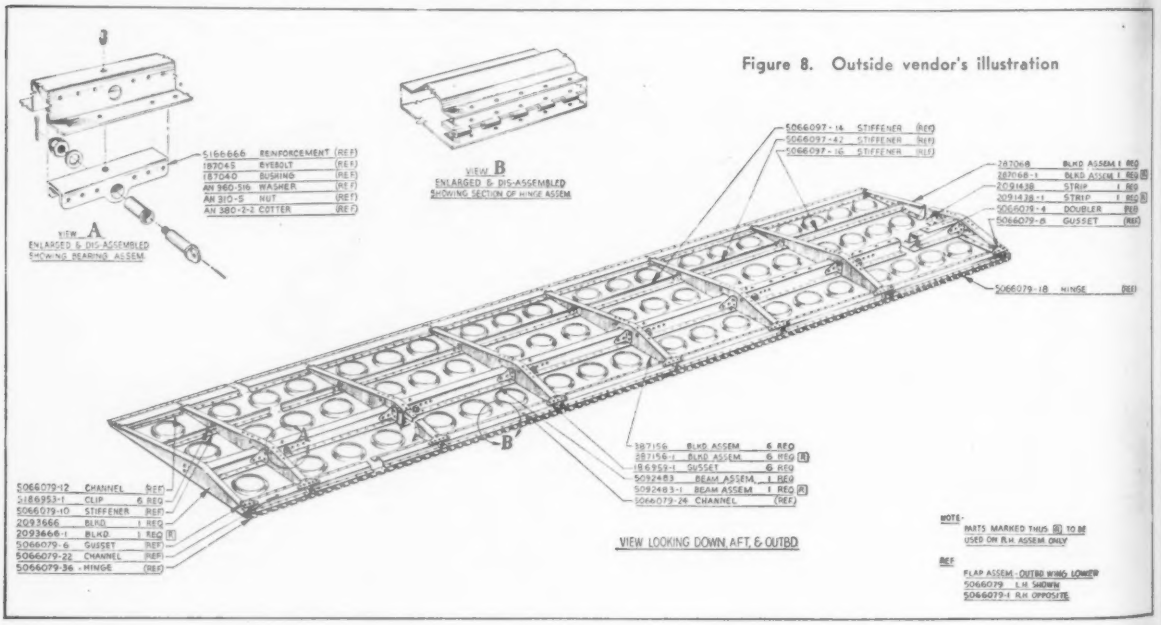
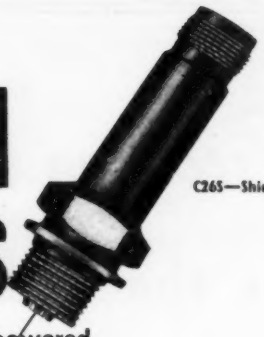

VIEW A
ENLARGED & DIS-ASSEMBLED
SHOWING BEARING ASSEM.
VIEW B
ENLARGED & DIS-ASSEMBLED
SHOWING SECTION OF HINGE ASSEM.
VIEW LOOKING DOWN, AFT, & OUTBD
NOTE- PARTS MARKED THUS [R] TO BE USED ON R.H. ASSEM. ONLY
REF FLAP ASSEM - OUTBD WING LOWER
5066079 L.H. SHOWN
5066079-1 R.H. OPPOSITE

Figure 8. Outside vendor's illustration

CHAMPION SPARK PLUGS



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provide dependable ignition for the Warner-powered Sikorsky Helicopter now in production for the Army.

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Champion Ceramic Aircraft Spark Plugs have, in a relatively short time, compiled an amazingly successful service record. It has been scored principally with the air forces and transport lines, where diversity of engines and operating conditions is the rule rather than the exception.

The exhaustive research, experiments and tests which are back of Champion Ceramic Aircraft Spark Plugs clearly indicated that here at last was a spark plug specifically designed to meet the ignition problems encountered in today's most advanced aircraft engines.

The day in and day out dependability of Champions in bombing, combat, patrol and other wartime duties has gained for them widespread respect and praise. Champions are true champions in fact as well as name.

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1. Immunity from heat and chemical reactions.
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Wings assemblies, precision parts for new giant bombers, liaison planes, trainers, and mammoth troop-carrying gliders are proof in the air —proof pouring from Industries' plants.

These proven skills, these experienced facilities, are at the service of the aviation industry — for available immediate production.

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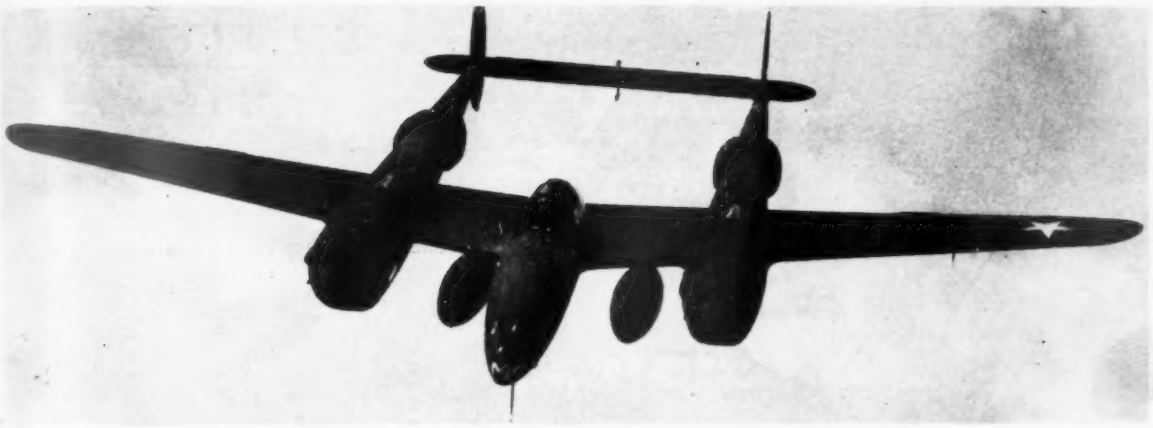


The light, disposable fuel tanks suspended beneath the P-38's fuselage decrease its speed only four per cent.

DROPPABLE FUEL TANKS

How Lockheed makes the droppable steel fuel tanks which double "Lightning's" range.

CONSTRUCTION details of the droppable steel fuel tanks which approximately double the range of the *Lightning*, were revealed recently by the Lockheed Aircraft Corp., builders of the *Lightning* and designers and builders of the tanks.

Costing less than a hundred dollars each, these tanks are replacing those formerly made of aluminum and which sold to the Government at $678 apiece. Weighing 90 pounds empty and 1,000 pounds when filled with 165 gallons of gasoline, they are so designed that two fully loaded tanks decrease the speed of the *Lightning* by only four per cent.

A mammoth drawing press at the Weber Showcase and Fixture Co., of Los Angeles, performs the first operation in the construction of the 10 foot long, 27 inch in diameter tank. After the sheets of 24-gauge deep drawing steel—measuring 48 by 144 inches and weighing 41 pounds—are prepared, they are inserted one-by-one in the press. A 10-ton die, made of Meehanite iron, and a pressure of 500 tons forms the halves.

After the halves come from the press, the outside flange, left by the operation, is hand trimmed and the halves are then inserted into a hydraulic press which punches the locating holes as well as the holes which will receive the vents, filler plugs and drainage connections. This is accomplished in a single operation, saving approximately two hours in the manufacture of each tank.

The halves are then shipped to a branch plant of Lockheed for welding and finishing. All operations at the Lockheed plant are handled through a conveyor system enabling output of a tank every 4½ minutes, 24 hours a day.

This conveyor system is of the overhead type from which cradles are suspended, each cradle holding one tank and the complete conveyor system holding 36 cradles. Welding and assembly equipment are located at various stations along the conveyor line in the sequence in which the operations are performed. This assembly conveyor is 475 feet long, ending on a freight platform where the tanks are packed in a crate for shipping.

The first operation in the Lockheed plant is the torch welding of the sump plug flange to the left hand skin, or shell. Next the filler well adapter assembly is seamwelded to the left hand skin. The special series welder, designed by Lockheed, is similar to conventional series seam welders such as those used in welding steel discs to shell forgings. However, it is somewhat unusual since the weld is made on a double contoured surface having a rise of ¾ inch in 90° of rotation.

The machine is equipped with two air cylinders to which the shaft housings, welding shafts and welding wheels are connected. The two cylinders and welding units are electrically insulated from each other and bolted to a casting which rotates on a hollow shaft mounted vertically. The inside diameter of this shaft is such that the water-cooled welding cables which connect the two sides of the transformer secondary to the cast copper shaft housing can be brought down through the shaft. The circular copper alloy short circuiting bar, the upper face of which is contoured to fit the inside of the tank, is mounted horizontally below the two welding wheels.

When the two wheels contact the tank skin, the welding circuit is closed by the short circuiting bar. Since the welding current flows through the sheets at two points, two welds are made simultaneously and the 360 degrees of welding is completed in approximately 185 degrees actual rotation of the upper heads.

After this operation bulkheads are then welded to both the left and right hand skins, seven to each shell. This is done in two semi-automatic welding machines. The first welds three bulkheads in place, the second the remaining four.

The half shell is placed in the machine, where it is supported at the bulkhead stations by copper alloy electrode bars which are machined to fit exactly the outside contour of the pressed-steel tank section. Lockheed incorporated into their design unique roll-spot welding units which rotate about the longitudinal axis of the tank and are fastened to the hinged cover of the fixture that holds the tank sections.

Each of these units consists of a welding wheel and shaft, shaft housing, guide casting, three inch diameter by ¾ inch stroke air cylinder, a 1/12 horsepower driving motor, reducing gear box and the necessary gear train to drive the welding wheel shaft. The sequence panel and welding transformer are outside the fabricating jig proper.

The roller spot welds are controlled by units consisting of a Westinghouse non-synchronous pulsation-weld timer panel with a Weld-o-trol Electronic Contactor. These timers were modified slightly to secure the desired sequence of operation.

Except in the two center bulkheads where the welds are spaced ½ inch, the welds are spaced ¾ inch apart, center to center. Welding time is one minute in each of the two machines, another minute being devoted to loading and unloading in each.

Now the half shells are placed on the

The tanks are stamped out in half-sections by a Weber drawing press.

moving conveyor. Flanged gussets and other parts which will hold the tank to the airplane are located and spot welded to the stressed bulkheads by a series of gun welders on monorails that enable the operator to follow the tank along the floor until his particular welding job has been completed.

The two halves of the pan are seam-welded to the halves of the tank with a portable seam welder designed and constructed by Lockheed. This welder is supported from a Chicago Pneumatic counter balancer of 175 pounds capacity. The welding is done while the half tank is on the moving conveyor. Since the linear travel of the wheels on the welder is approximately the same as that of the conveyor, the wheels were designed to rotate in the opposite direction to that of the conveyor. The result is that the welder actually moves less than 18 inches during the welding operation.

The halves are tackwelded together by a gun welder, and the tank is taken off the line, placed in a special cradle and run through a National Seamwelder that completes the mating operation. This seamwelding is done at the rate of 60 inches a minute, or a total of four minutes per tank.

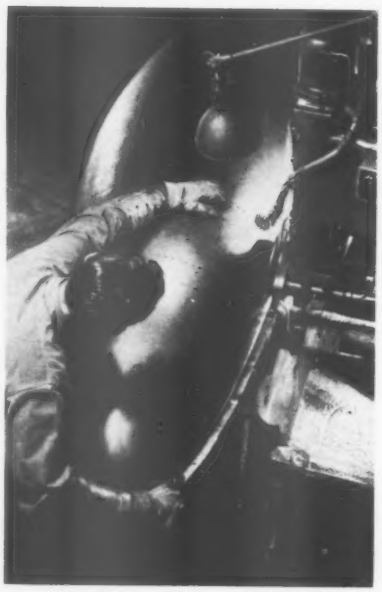
Excess material on the standing seam is trimmed off with an electric shear, the tail plug flange is torchwelded in place. The tank is then placed back onto the conveyor where air pressure pumped inside and an application of soapy water outside test the tank for leaks, which, if present, are immediately repaired.

The tank is now ready for the slushing table, which holds two tanks, one on each side. In each tank are poured 30 gallons of special non-inflammable zinc chromate primer. The table is so rotated that the fluid flows over every portion of the inside of the tank, after which the tank is loaded onto a drying dolly and dried with a hot air hose.

Then the tank is given its final pressure test, the permanent tail plug is screwed in place and the tank placed onto the second or process conveyor. This conveys it in turn through a hot Turco bath cleaning solution, a cold water rinse, a drying oven and a paint booth where two primer coats and the final camouflage paint are applied.

This same conveyor then carries the tank into the shipping building where a girl installs decals showing the manufacturer's nameplate, tank capacity, etc., and where anti-sabotage seals are placed over all openings. A protective coating of Paralketone is applied by spray gun, and the tank is ready for crating.

Once fastened in place beneath the wing of a P-38, a Vega *Ventura*, a Vega PV-1 for the Navy or another American plane, the tank, helps these aircraft to reach their distant destinations by increasing their flying range. END



Halves are seam-welded by electronically-controlled resistance welders.

EQUIPMENT

MIDGET SEARCHLIGHT

A MIDGET searchlight only as big as a walnut, yet so powerful that it will project a 1,500 candlepower beam visible for 60 nautical or about 70 land miles, has been designed by Westinghouse engineers to aid the rescue of aviators forced down at sea.

Packed with rubber life rafts with which all ocean-flying military aircraft now are equipped, one of the tiny lamps will be worn by each man of a crew, fitting on a band around the head like miners' caps so the crew members may have both hands free to hold on in rough weather.

The lamps are wired to a small hand-cranked generator included in the raft equipment to supply power for radio. They also can be flashed as signal lamps by means of a trigger switch. The lamp, intended as a complement to the raft radio, is mounted in a waterproof housing to protect it from damage and contains a single tungsten filament.

POWER ACTUATORS

CARBON dioxide gas, already used to put out fires and inflate rubber rafts and life vests, now has been harnessed as a source of emergency power through a new device developed by engineers of Walter Kidde & Company.

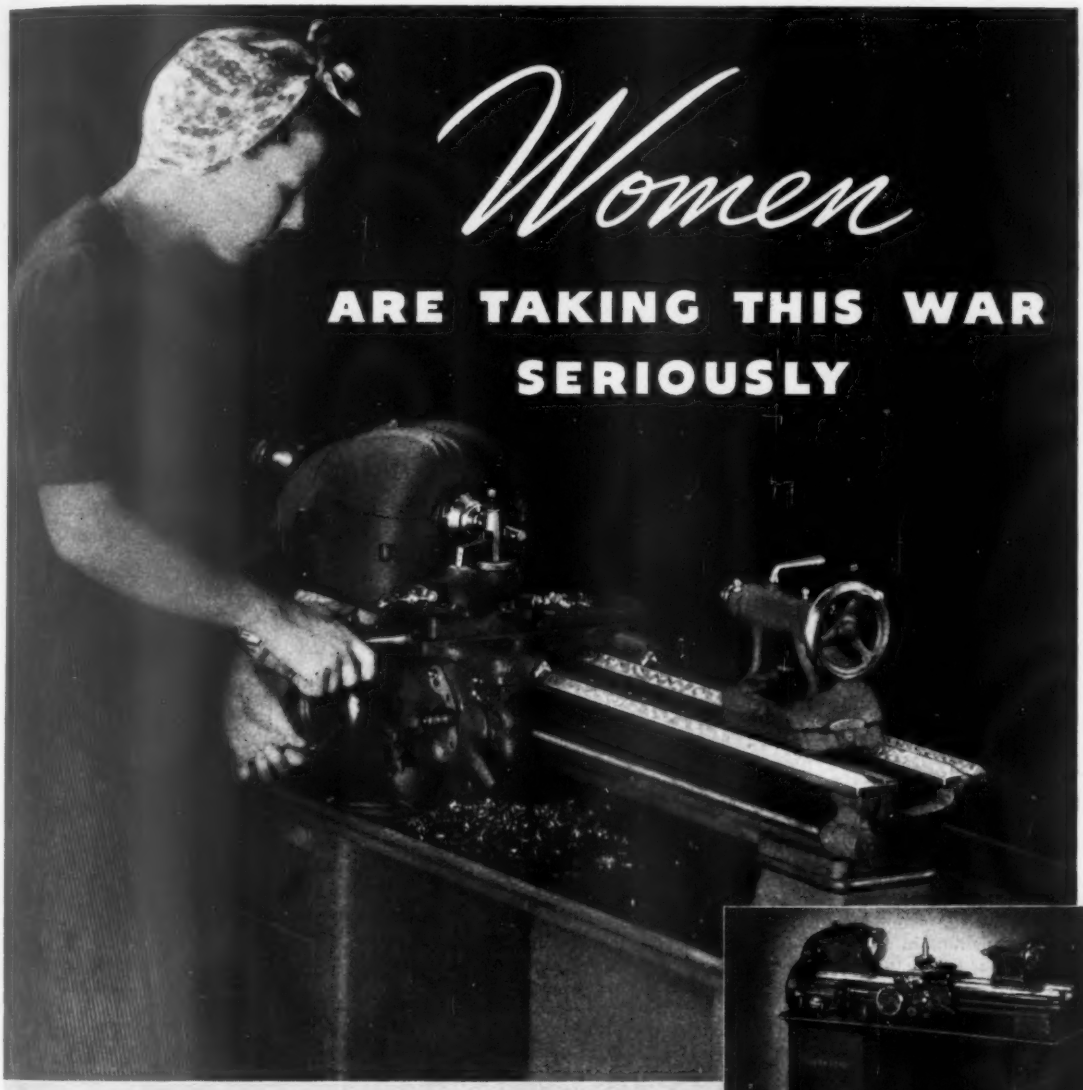
Known as power actuator cylinders, the new devices consist of steel bottles filled with compressed carbon dioxide and connected to the pistons of hydraulic systems used to open bomb bay doors, to lower retractable landing gear and to apply brakes. When the regular hydraulic system fails or is damaged in combat, the compressed gas is released into the system to operate the pistons.

THREADED INSERTS

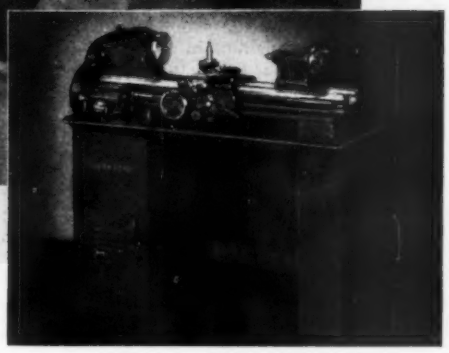
FOR many years, the simplest way of fastening two parts together has been by means of a bolt and nut. Where it has been impossible to go through to the other side, the stud has been employed. When the stud was first devised, engineers thought one of their major troubles had been solved. In practice, however, studs come loose, despite special thread fits designed to prevent loosening.

This difficulty has now been met through development by Jose Rosán of Hollywood, Calif., of a simple ring with serrations inside and out. In practice, the stud is installed by customary methods, and the serrated ring forced into place over interlocking serrations built into the stud head, making a tight fit flush with the surface of the material in which it is used. Similarly, the insert may be locked in place by means of the same interchangeable serrated ring.

Both the stud and insert have been found to possess many applications to aircraft and engines, and to have solved a number of operational and service problems.



SOUTH BEND LATHES



9" swing, South Bend Engine Lathe

With grim determination thousands of American women are doing their best to fill men's shoes. Eagerly they bend their shoulders to wartime tasks—for no sacrifice is too great if it hastens the return of their men from the fighting fronts.

In hundreds of vital war plants, women are operating South Bend Lathes with surprising results. On all kinds of jobs, they have kept up production and maintained established standards of precision. In some factories whole batteries of South Bend Lathes are humming under the guidance of feminine hands.

Since World War I, women operators have preferred South Bend Lathes. Their nimble fingers find the convenient controls well suited to their sensitive touch. They like the fully enclosed design. And, most of all, they appreciate the ease of operation that prevents fatigue and makes the workday seem shorter.

South Bend Engine Lathes and Toolroom Lathes are made in five sizes: 9″ to 16″ swings, with 3′ to 12′ bed lengths. The Turret Lathes are made with 9″ and 10″ swings. Write for Catalog 100C which describes all sizes and types of South Bend Lathes.

BUY WAR BONDS

SOUTH BEND LATHE WORKS Lathe Builders for 36 Years
SOUTH BEND, INDIANA

Production Illustrations

(Continued from page 108)

Job illustrations make it possible for the leadman or supervisors to explain to personnel (inexperienced or otherwise) in the shortest possible time the job they are to work on. Figure 5 illustrates their use.

C. Sub-Assemblies: These illustrations are made concurrently with job illustrations. Sub-assembly illustrations are for bench assembly or sub-assembly jobs. Bench assemblies are shown as they will look completed. These sub-assemblies are really a type of job illustration, but usually differ in one respect—they are usually complete on one illustration. They are used in the same manner as the job illustrations.

D. Outside Vendors' Illustrations: This type of illustration is made at any time during the contract but usually near the beginning and after the completion of structure and system illustrations. In most large production plants some jobs are subcontracted to outside vendors, especially now when sewing machine manufacturers are making machine guns, refrigerator manufacturers are making aircraft parts, etc.

The plant must know that the outside vendor can meet his schedules and that he knows what the job entails. On the usual outside vendor's item, it is requested that it come in complete, ready for assembly on the airplane. To accomplish this, a large number of engineering drawings must be sent to the vendor. We find that a better conception can be obtained, better answers and decisions can be reached if an outside vendor's illustration is made, explaining in detail, pictorially, the unit he is to manufacture.

These illustrations are usually made from engineering structure and system illustrations.

E. Miscellaneous Manufacturing Illustrations: The illustrations occur throughout the entire life of the contract. They carry specialized information and are usually made for the following functions: Service bulletins and manuals, time studies and clarification of a specific shop problem or proposal. The person requesting the illustration is the authority for the information contained.

Conclusions: With the preceding facts in mind, a new conception, perhaps, of the intricacies and responsibilities of a production illustration group has been realized. A production illustration group within a large plant must operate as a miniature complete department whether it is so designated or not.

Co-ordinators are responsible for complete model programs. Checkers must have complete information about the product. Leadmen handle not one but all sections of the product. Distribution must be handled efficiently. If the production illustration group is to be a good plant investment, it must have good organization and presentation with all illustrations classified and recognized by the plant. END

SYNCHRONIZES MULTI-ENGINE SPEEDS AUTOMATICALLY

AUTOMATIC and simultaneous synchronization of the engine speed of four engined aircraft has been made possible by a new, simplified device developed by the propeller division of Curtiss-Wright Corporation.

Known as the Curtiss Automatic Engine Speed Synchronizer, the device enables pilots and flight engineers of multi-engined planes to obtain the desired speed settings for all engines at the same time by operation of one control knob. The synchronizer adjusts all propeller governors so that they change the blade angle on each propeller to produce uniform engine r.p.m. The conventional propeller control system requires that the pilot manipulate four separate levers, one by one, to synchronize the engines.

Synchronization is vital in multi-engine installations in order to reduce dangerous vibration caused by varying engine speeds. The mechanical connection usually required with individual constant speed governors has been eliminated in the Curtiss synchronizer system.

Airacobra Wings

(Continued from page 104)

A drag chain hauls the dollies—at a rate which has been greatly accelerated since the lines first began to move. The track on which the chain moves is in a channel attached to the factory floor and is located directly under the fixtures, thereby eliminating danger to workers.

The drag and return chain run in two channels, one above the other. Each line has its own power and gear box. Three wheels support the combination fixture-dolly, the tailwheel being grooved to ride on an inverted angle iron next to the chain support. The two outer wheels at the head section of the combination fixture-dolly travel on flat plates. The first station is located on the feed line, where leading edge, rear beam and three bulkheads are assembled and a small amount of drilling is done.

As the line travels its route, parts are fitted, drilled, tested, inspected and removed for such chores as dimpling, countersinking or cleaning. If the particular chores are bench operations, the part is removed by dispatch women to the benches and returned in a given time to an advanced station where permanent assembly takes places.

All electric and air-operated tools used on the wing line are suspended from automatic reels, and the tools remain at any desired height when pulled down.

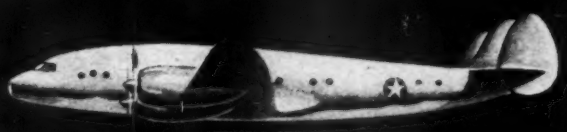
The leading edge of the wing is positioned parallel to the floor in the fixture-dolly. As the panel progresses along the line, work on the trailing edge starts, and because the trailing edge is higher from the floor, work platforms are used through the stations on which the trailing edge is assembled.

Painting of some parts takes place early on the line. An extension has been developed which completely conveyorizes the painting process. Panels are next taken off the wing line by an overhead crane, placed on a transfer fixture-dolly and carried to one of several stations set up for drilling of the inboard ends.

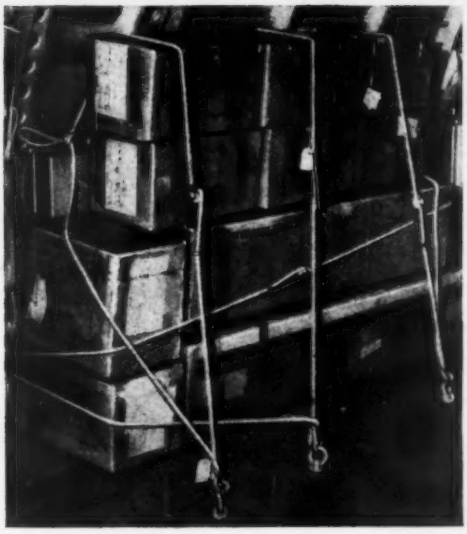
After the drilling operation is completed, the panel is moved along for washing with solvents, masking, preparation for painting, glazing, drying, painting of insignia and stripes, and final painting of the panel. Movement is by monorail.

The monorail runs in the same direction as the wing lines through stations which prepare the metal for painting. The return line of the monorail is the drying station, after which a second curve in the rail directs the panel back through the paint shops to waiting highway conveyances.

The monorail then carries the spare wings back to the starting position of the paint conveyor where the wings complete the cleaning and painting cycle along with the regular panels. END



Two types of containers are held securely and safely by Evans Skyloader rods and beams. The metal tie rods fasten to floor rings and the hardwood beam is locked tightly against the cargo. Simply unlocking the beam frees the cargo for offloading.



Large packing cases are made fast by Evans Skyloader rope hooks and tighteners. Ropes are fitted to floor rings by hooks, made taut by a twist of the tighteners, removing all slack from the load. Cargoes are made safe in flight and easy to handle.

"of shoes—and ships—and sealing wax!"

Air cargo—the newest form of freight shipment—demands new loading and handling techniques.

To meet the special physical factors imposed by aircraft design and mixed cargoes, Evans Skyloader Hold-down Equipment provides both the necessary mechanical units and the technique of simple application to assure utmost safety and protection.

Evans Skyloader Equipment is winning international recognition through superior performance records in the air and on the ground.

Save time and money on your air cargo handling! Get the facts about Evans Skyloader Equipment. A new, Evans instruction manual—"How To Hold Down Air Cargo", is just off the press—write for your copy.

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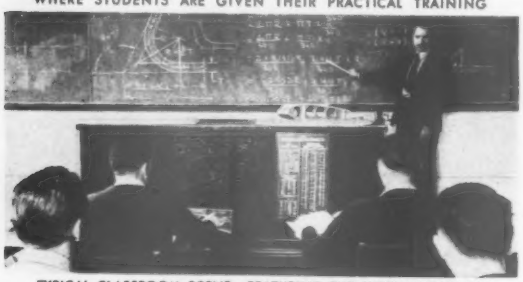
A CORNER OF ONE OF THE AIRCRAFT MECHANICS SHOPS—WHERE STUDENTS ARE GIVEN THEIR PRACTICAL TRAINING



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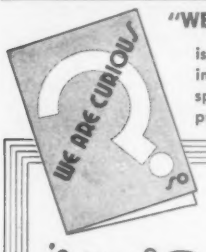

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Direct Entrance from Grand Central Terminal

Airport Hazards

(*Continued from page 53*)

(*b*) "On all areas within approaches to runways, existing or proposed (not used for instrument landings), on a ratio of one foot vertically to forty feet horizontal distance from the end of such runway.

(*c*) "On all areas not included within approaches to runways, on a ratio of one foot vertically to thirty feet horizontal distance from the outside boundary of the airport; provided, any structure within the protection area may be limited to a height of one hundred feet.

(4) "The commission may require installation and maintenance of signs, lights, beacons, landing aids or equipment or other structures either on or off the airport when and where necessary.

(5) "The commission may institute and carry on any litigation or proceedings necessary to enforce its regulations when fixed within provisions of the law.

(6) "Master plans for present and future development of the airport are to be filed with the commission.

"In fixing height limitations by the above scale, the mean level of the usable end of any runway shall be used, and the mean level of an area not within runway approaches shall be determined by using the mean level of the airport from its center in any direction to its outside boundary.

"Structures are defined to mean anything which is above the surface of the ground, thus including trees, fences, haystacks, buildings, derricks, poles, wires, tracks or anything of whatsoever kind.

"Approaches to ordinary runways are limited to a maximum width of 500 feet on each side of the center line of such runway extended to the outside boundary of the protection area. On instrument landing runways this is widened to 750 feet."

By the foregoing a definite standard is fixed by the law itself; but this is the maximum regulation allowed. In most cases, it will not be necessary to impose the maximum, and it is made the duty of the commission to determine in each case just how much of the restriction shall be imposed. When the commission has done this and properly notified all those affected, then it is made unlawful to erect or maintain any structure in violation thereof.

Of course, in order to take care of special situations, unnecessary hardships and the like, adjustments and special exceptions to general regulations are permitted upon application and hearing. If the applicant is not satisfied he may appeal to the courts, thus affording him "due process of law."

The above is merely an outline of the skeleton around which a law, approved by all those mentioned, has been prepared. It will, in all probability, be passed by several state legislatures meeting in the early part of 1943.

From the above statements, the reader may be asking how such a law, and such a commission, apparently intended to infringe upon rights of property owners, can be valid in the light of the constitutional prohibition mentioned at the beginning of this article. The answer must be that it cannot, except in a limited degree; but the problem is handled in another way, as mentioned later.

Under the proposed laws recommended by the CAA as well as the National Institute of Municipal Law Officers, it has been proposed to require the issuance of a permit by some board before anything may be erected in an airport protection area. Where tried out this has been found too cumbersome. Why should a farmer, for instance, be required to file an application before a board, return later for a hearing and then obtain a written permit, merely to build a corral or set a fence post in cases where it could not be a hazard to flying? Why restrict anyone unless he would violate the safety regulations?

Both of the above proposed laws have another fatal deficiency: Each proposes to enforce the regulations without payment of any compensation to the property owner injured thereby. Could anyone require the owner of a house to tear it down, no matter how great a hazard or obstruction to flying it might be, without paying him for the damages? Of course not; the answer is obvious. Yet proponents of these laws profess to believe that courts will uphold them on the theory that they are "zoning laws" similar to those upheld generally by the courts.

A very brief analysis will show the fallacy of that theory. The courts of the nation have upheld zoning laws by basing their decisions upon the sole premise that such laws are for the protection of the public in that they tend to prevent fires, panics, epidemics, traffic congestion, increase of crime and the like. This is because zoning laws have always been adopted in crowded cities where persons are "stepping on each other's toes."

Can this theory be carried out into the country and applied to airports? There is seldom any congestion of population sufficient to warrant anything more than very limited zoning regulations.

It is the theory of some, however, that the safety of the public traveling by air, or in Army service, is sufficient to support such regulations without payment therefor. If that be true, it would be just as reasonable to enact a law prohibiting any farmer from raising tall corn in the field adjoining a railway or public highway crossing because it might obscure the view of a grade crossing. No one would contend that such a law would be valid.

Therefore, in the law under discussion here, it is proposed that the regulations imposed shall be enforced without payment of compensation, only up to that point where the same is reasonable under the particular circumstances of each case; and after that to provide a system where-

(*Continued on page 123*)

Here's an Aircraft Instrument that never leaves the ground

In hundreds of control towers guarding America's forty thousand miles of skyways, Kollsman altimeters are vital "reference points" for planes in flight. Pilots radio these towers for "the Kollsman"—the barometric pressure setting shown by the station altimeter. The pilot's own Kollsman altimeter is then set to correspond—a procedure vital to maintaining airway traffic flight levels, and in making safe landings. The first commercial sensitive altimeters were products of Kollsman research—20 times more sensitive than then existing types. Since then—on the ground and in the air—they have become the standard of safety and reliability in the operation of American aircraft.

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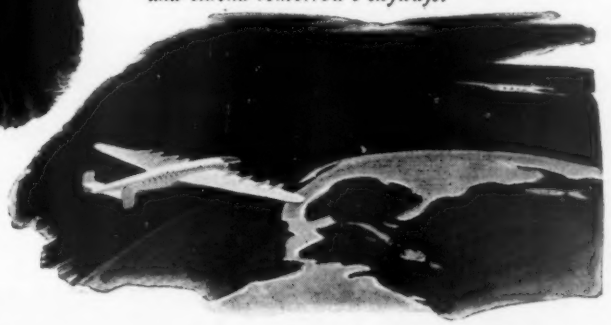

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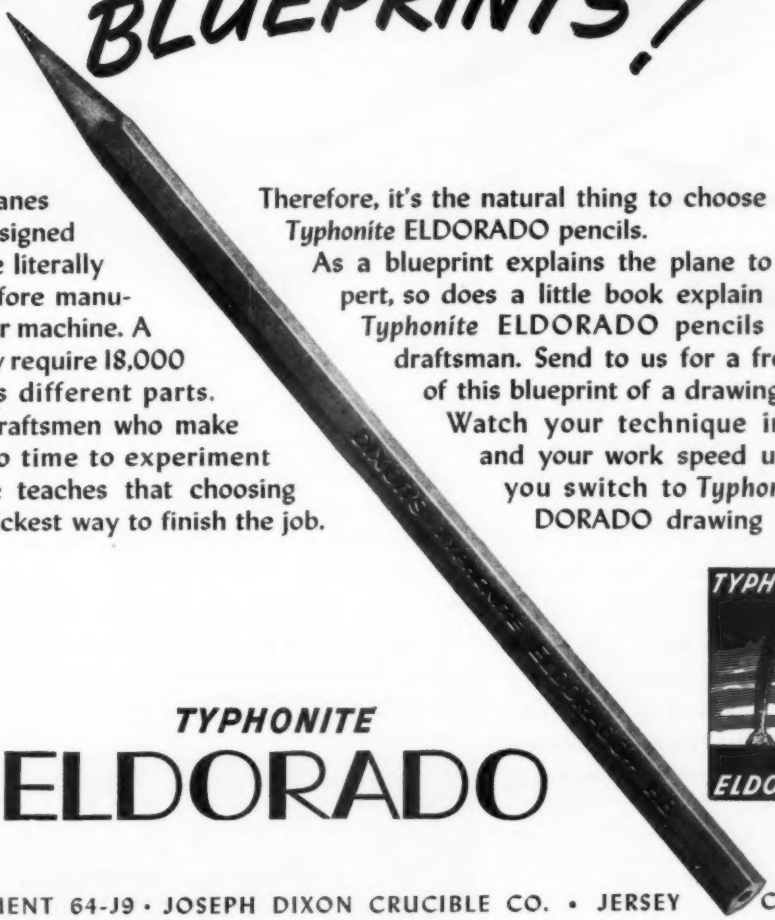

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FLEETWINGS

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(*Continued from page* 118)

by payment may be made without injustice to the airport or the property owner.

For instance, if the height regulation imposed off the end of a runway used for instrument landings limits the use of a strip of property across the road to such an extent that houses cannot be erected on it, the airport may condemn an easement on the land corresponding to the limitation imposed, paying the small cost thereof, without having to purchase the land outright. If, on the other hand, it did not want to do this, the property owner would not be required to observe the regulation. However, the airport would not lose the right to follow this proceeding at any time in the future, thus merely running the chance that costly buildings might have to be condemned at a later time. The airport would also have a right to install and maintain obstruction lights and beacons or other structures as landing aids by following the same procedure. Under present conditions, an airport has no power to protect itself; under the above procedure, it would have full power to do so without unreasonable cost therefor.

In order to guard against overlapping regulations where airports are less than six miles apart, a regional airport commission is set up with authority to coordinate plans and regulations in such cases. This commission would be made up of representatives of each airport and others affected, with its jurisdiction covering the county. Also, to co-ordinate the work and plans of county or regional commissions, it is provided for supervision of these by the state planning board or other similar state authority, already existing in most states.

Also, in many states there are laws providing for organization of regional planning commissions, and these are necessarily brought into the set-up to coordinate all plans for development and expansion (as well as location) of airports, as the same might affect highways, bridges, building development, railways, water and sewage facilities and other public utilities.

If not already authorized to do so, such regional or county planning commission is given authority to make and enforce zoning regulations, in the same manner as in cities, insofar as conditions may require, based upon comprehensive surveys and plans designed to protect the public peace, health, safety and general welfare. In this way, control may be retained around airports, at least to a limited degree, and use of land and buildings near Army or Navy airports for unlawful or injurious purposes regulated.

Space will not permit further elaborations on the details of administration, personnel and expense of enforcement, but these all have been satisfactorily worked out in full. For various reasons, names of those experts and employees in Governmental as well as military positions who have contributed much study, time and expert advice, as have officers and employees of commercial aviation interests, cannot be listed at this time. It is sufficient to state, however, that the above represents a compilation of the best efforts of all these, made over a period of more than three years of work, study, observation and experimentation covering the airports of the nation.

It may not be all that might be desired, and there will be some who disagree. But all those who have had a part in it feel that it is the best which has been yet devised, and that it "will get the job done." END

15 YEARS AGO

FROM the September, 1928, issue of this magazine:

Cessna cantilever cabin monoplanes were being offered complete with brakes, air speed and Wright *Whirlwind* motors for $9,800, all fly-away Wichita. . . Crop surveys by airplane had already been made by the U. S. Department of Agriculture and author S. R. Winters speculated about the future widespread use of this method of inspection—especially for crops damaged by hail, wind or storm.

* * *

The Army Air Corps believed it had overcome the problem of propellers shattering at high speeds by uncovering incipient flaws in duralumin props through a nitric acid surface-etch treatment. . . Lieut. Henry H. Ogden described the forced landing of his plane, the *Boston*, between Scotland and the Faroe Islands on the first circumnavigation of the globe by air in 1924. . . Col. William B. Greeley, former chief of the U. S. Forest Service, declared that airplanes could be employed successfully as an adjunct to ground forces in fighting forest fires.

* * *

John P. Wood, piloting a Waco plane powered by a Wright J-5 engine, won the 1928 National Air Tour which started from the Ford Airport at Detroit on June 30. Frank Hawks, piloting a trimotored Ford, was second and Randolph Page with a Stinson *Detroiter, Jr.*, was third.

* * *

The new distance-duration record for aircraft was set in July by Capt. Arturo Ferrarin and Maj. Carlo del Prete in a flight from Rome to Brazil. Total distance was 4,888.2 miles and elapsed time was 51 hrs. 39 min. . . Peter Hesselbach flew the sailplane *Darmstadt* to a new U. S. record at Cape Cod, Mass. . . With 20 air mail routes in operation and others contemplated, the plans of the Post Office Department for an airway postal service were taking definite shape.

Combat Films

FILMS made during actual combat are helping RAF gunners and fighter pilots revolutionize techniques of air attack. The pictures are made by tiny cameras set in the starboard wings. Afterwards they are studied carefully by the men whose mistakes are pointed out to them.

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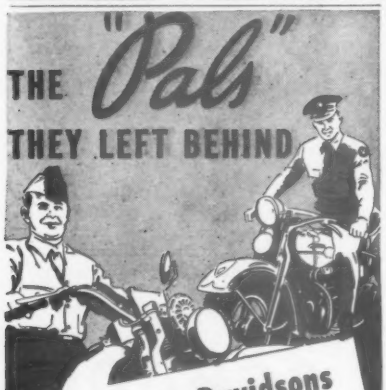

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Air Evacuation

(Continued from page 23)

track rail line with other uses—less than a thousand wounded were brought back to the rear in the conventional hospital train.

The Americans never did have a hospital train in Africa. The British had one or two, but they largely abandoned their rail transport of wounded in favor of the proven superior efficiency of transport by air. They have seen the logistic superiority of that method.

The largest factor of that logistic equation, however, represents a distinct departure from the beginnings of Dr. Chassaing and Major Epaulard. Those pioneers—and most of the American manufacturers who have designed and tried to sell "ambulance planes"—neglected the factor of which the Americans have taken such superb advantage. Our wounded have not been carried out in ambulance planes that were designed for no other task and which, had they been used, would have flown one-half the journey, that to the front, practically empty. They have been carried out to safety and recovery in those same C-46's and C-47's, the workhorses of the Air Transport Command, which have served so brilliantly in getting combat men and material up to the front.

The superb logistics of the evacuation of wounded is that they used the empty return space of the transport planes instead of demanding their own special jobs.

It is only just beginning to dawn on veterans what an efficient military operation this has turned out to be.

"When I think," said one of General Somerville's old timers, "What a headache the wounded used to be in the last war! You couldn't put them in a freight car—yet our freight cars were rolling back empty from the front. You couldn't put them in a truck—and our trucks were doing a one-way job. You had to have special medical trains and special ambulances, that rolled *up* to the front empty, cluttering the roads and the rails.

"And then along come these birds of the Air Forces and all they want is a few steel arms, and, better yet, a special design for the webbed lashings in a C-47, and all three problems are solved."

True, that is all the Air Evacuation personnel asked. With folding steel arms to hold litters and special web straps to form the litters, the C-47 can bring back four tiers of wounded. Two interior arrangements of the plane are in use. One can carry 24 men prone in litters and the other carries upward of 30 sitting. When not fully loaded, of course, the planes can and do carry any other material that can be stowed aboard within the load limit of the airplane, and extra space is often put to good use.

"I saw a plane come in across the Atlantic," says a flight surgeon, "with 600 pounds of mica, 24 wounded, a general and his staff and three men from the State Department."

That same plane had probably made the eastward flight loaded with engines, parts, or generals. Then, on the westward trip, at no extra logistic cost, it brought very much closer to a happy and successful rehabilitation 24 lads who had done everything a man could do—and deserved everything that home could do for them.

A look at the inside of a C-47 filled with litter cases is about the most impressive demonstration possible of this logistic development. They lie in their litters, wrapped in blankets, four deep along the walls of the cabin. A flight surgeon and a staff sergeant, or a flight surgeon and a nurse patrol the wide aisle between. A 50-pound chest holds all that is needed for their comfort and attention from bedpans to dressings and pills. Plasma equipment is also aboard. And, as the plane rushes them smoothly at 200 m.p.h. or more towards a cool, screened, fully equipped hospital, they get everything they need.

The flight surgeon and nurse, or the nurse and the staff sergeant, are part of the plan, too. They are members of squadrons specially trained for this task at Bowman Field, Louisville, Ky., and designated the Medical Air Evacuation Transport Squadrons. Their whole duty is to make the trip to the front in pairs in the crowded transport planes and ride back with the wounded. With their 50-pound chest the team weighs a total of not more than 400 pounds, a scant price to pay against the tons of medicines and foods and personnel which would have to be transported to areas just behind the front were these boys to receive adequate care by any other method.

Or, were these boys to be carried, say from the Tunisian battle back to the base hospitals in western Algeria, it would have meant that they jogged for four or five *days* over the single track railway or jounced for an equal time over the crowded roads. The airplanes, otherwise flying back empty, make the journey in from four to five *hours*.

And when they arrive at that base hospital in western Algeria the very layout of the place is balm to a wounded boy who had, perhaps, visions of days and weeks in a tent or a board shack some place in the desert or the hills. The Army has taken over, entire, a fashionable French watering place. Its villas and chalets climb up through groves from the sea. Most of them are the last word in luxury. All are comfortable. Groups of them are divided into wards, according to their medical or surgical purpose. Hotels and casinos provide the central buildings for operating rooms and therapeutic devices. And there, thanks to transportation by air, medical and surgical aid can be concentrated far from the battle front far more effectively than it could be up under bomber range.

The last remark, of course, brings up the question as to how safe our wounded

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are in air evacution by planes not marked with the Red Cross. None of these planes, of course, can in honor be so marked, for they are used on the forward trip for the carriage of distinctly combat material.

Well, in the first place, they return, as they go up, under adequate fighter escort. They move, if possible, at night. In modern aerial combat it is doubtful how much protection the Red Cross on an airplane would be in any event. Attack pilots come in on a strafing expedition so fast that it would be doubtful if they could recognize Geneva's markings *before* sending home their bullets. Adequate fighter cover, our people believe, is better protection.

That applies particularly to the African theater. Against the Jap in the Pacific, the Red Cross has proven to be no protection at all. The Jap has torpedoed hospital ships plainly marked at sea. He has strafed hospitals plainly marked on the ground. His own soldiers commit hara-kiri when cornered. There is no reason to believe that his pilots would be more kindly to our own wounded boys. Hence, adequate fighter cover is the answer in the magnificent evacuation job that was done from Guadalcanal and that is being done from New Guinea, China, and the islands off Alaska.

Its speed and efficiency and economy are indeed a striking demonstration of the value of all air transportation. Brig. Gen. David N. W. Grant, the Air Surgeon, Army Air Forces, told in a speech in New York how an entire 250 bed field hospital had been removed to the rear when the Germans *came* crashing through at Kasserine Pass. The whole operation required 40 airplanes and was accomplished in a single day.

New drugs and new procedures have already been given ample credit for the remarkably low death rate among our wounded. The entire Army is beginning to see that air medicine's solution of this problem of logistics should have much credit, too.

And as for the wounded themselves, it's a few minutes smooth travel in the air against hours of jouncing on the road. It's a few hours in the air with skilled attendance against days and nights of agony in crowded, dust filled, rattling hospital trains. Ask those boys. They know. END

I Learned About . . .

(*Continued from page 70*)

Then, at last, I knew exactly where I was because I had often used that steeple as a landmark for judging turns and approaches.

Trying to visualize the entire layout of the field and estimate distances as well as possible, I made my turn into the wind and ducked as cautiously as possible into the fog.

I was immediately swallowed up and practically digested by the fog. The windscreen up front became a mass of white nothing and I really couldn't tell whether I was level or upside down, turning or flying straight, climbing or diving. I prayed that I was doing the right things at the right times.

Throttle was back as far as feasible and I was trying to keep the nose down only a little so that there would still be time to pull up and away in case high-tension wires or other obstructions loomed in my path by some error in judgment.

Then I dimly saw a bridge. "That must be the Old Country Road," I remember saying aloud, and I raised my nose slightly and advanced the throttle to stretch out the approach. And then, sure enough, the field fence passed beneath me and I could see Air Associates' building off to the right a bit.

In at last—and right on the button!

I landed safely without further ado and taxied up to Hangar 7. Vic Marks was standing there by the fence when I climbed out, somewhat dejected and thoroughly beaten. Vic probably realized what I had gone through although it didn't dawn on me at that time that he had undoubtedly suffered even more than I. He didn't say a word about the flight—not then. Later, though, I got hell aplenty from him.

I know enough about the aerial poker game now to realize that sometimes it's a better idea to sit one out and wait for a new deal in weather. END

THE LIBRARY

HOW OUR ARMY GREW WINGS; by the late Col. Charles deForest Chandler, U. S. Army, and Frank P. Lahm, brigadier general, U. S. Army, retired; published by The Ronald Press Company. Price, $3.75.

This is a thoroughly-documented and detailed volume covering the romantic but danger-ridden pre-war aviation era in the United States, including the many years of experimentation with lighter-than-air craft, written by two men who saw most of it happen. We read of the early exploits of one Lieut. Henry H. Arnold, now commanding general of the Army Air Forces; of the wind tunnel to which the Wright brothers attributed their success; of the untimely death of Lieuts. Thomas E. Selfridge and G. E. M. Kelly; of the first bombsight invented by Riley E. Scott in 1911; and how Glenn L. Martin obtained his Expert Aviator Certificate in 1912. Illustrations are frequent and well-chosen. Brigadier General Lahm was one of Wilbur Wright's first flight students, became the Army's first airplane as well as airship pilot, and Colonel Chandler, then captain, was in command of the first aviation school at College Park, Md. "How Our Army Grew Wings" is a valued addition to the published record of flight.

HE'S IN THE PARATROOPER'S NOW; by A. D. Rathbone, IV; published by Robert R. McBride and Company in 1943. Price, $2.50.

The author has compiled a highly interesting and factual account of the training and duties of the U.S. paratrooper. The reader is taken behind the scenes at the paratrooper schools and learns how "soldiers from the sky" are made. It is a good study for the reader interested in military affairs and good reading for those who are not. Its many illustrations portray the various phases of training.

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War and the CAA

(Continued from page 58)

his wares on his back has nothing on these CAA wheelhorses. If two of them start on an automobile trip to meet their assignments, the back of the car is almost full of foot-thick brief cases, special examination papers, parachutes and flying togs. When they fly, they trim their equipment to bare essentials.

Nor do the "Information Please" experts have much on these inspectors, either in the breadth of their knowledge or the impromptu nature of their regular performances. "Entirely unrehearsed and impromptu" the inspectors arrive on the scene and start operations. They could never prepare for the myriad questions and problems presented to them. There is no way of their anticipating each day's problems.

One of the worst problems these war days is that presented by the eager girl or boy who wants to fly. First, they usually want a free Government course, and it takes time to explain why none of these are available now. Then they want to know how they can learn to fly, and it takes more time to expound the restrictions which war has thrown around civilian instruction. If you can show, the inspector patiently explains, that the training which you are to receive will improve your ability to help in the war effort, and if you can show your financial ability to purchase this training within a reasonable space of time, and if you can find an operator who has the equipment and the time to train you, you may then proceed. It takes time to get all that across, especially to an individual who has made up his mind to learn flying regardless of obstacles.

Bad weather presents another problem. Most examinations for ratings require actual flying with the applicant. It is a lucky team of inspectors who can so arrange their schedule that every good daylight flying hour is used, and a full day of written examinations carried on, along with many inspections of the operator's shops, his repair work, examination of private planes that have been damaged and repaired, periodic inspection of aircraft used in instruction, and a dozen other jobs, most of which must be done at almost every stop.

He will start the examination, leave the class in charge of another inspector and then take off to give his flying examinations. Or, he may give all his written examinations after flying hours. Incidentally, all papers are of the multiple choice question type and answers are graded mechanically in Washington on machines. Again, an inspector may have several mechanics up for licenses and take them into the shops where they will weld and display their practical knowledge while another section is taking written examinations.

In the midst of any of these programs, the CAA inspector is liable to receive an emergency call to investigate an accident, in which event he must leave all of his routine operations immediately and fly or drive to the scene of the accident.

In these war days, an increased number of instructors are being produced by the War Training Service of the CAA, and an instructor's rating application ties up an inspector for a considerable time. He can start the average pilot applicant off for the solo portion of his flight test and watch him from the ground, and sometimes conduct other business while he watches, but he must ride the entire time with the prospective instructor. In this process he is alternately the instructor and the instructee. He may call on the candidate to instruct him in the technique of recovering from a spin, or he may take the controls himself and correct a candidate's taxiing methods. If a student fails in this examination, the inspector usually feels bound to explain in detail his shortcomings and advise on future study before the next appearance for an examination. Not infrequently he spends considerable time with the unsuccessful candidate explaining his faults and the subjects in which he needs further training.

Variety does lend some charm to the inspector's day. He never knows who may be waiting when he lands. It may be a pilot with a physical deficiency on whose actual flying ability the CAA medical division wants a practical inspector's report. It may be several dozen pilots who want their identification cards executed, including the fingerprinting. It may be a long conference with the officers of a flying school to determine whether they have qualified their organization as an "approved" school under CAA rules.

The planes these men use are units of a fleet of about 216 owned by the Civil Aeronautics Administration, a fleet in which almost every known make of airplane manufactured in this country is represented. They are the familiar black and orange planes which have identified CAA officials for years. They are mostly of the "taxi" type, the kind suitable for getting from airport to airport in the shortest time, carrying few passengers and not too much load. Such planes as Wacos, Fairchilds, Rearwins, Pipers, Stinsons and Cessnas predominate although there are other larger planes used for specific purposes. Alaskan travel, for example, is mostly in bi-engined planes for safety reasons, and the planes used at the experimental station at Indianapolis, Ind., and at the standardization center at Houston, Tex., are also larger and of the "flying laboratory type."

License numbers for these planes run from 1 to 250. Many are used by inspectors of the Safety Regulation Service and inspectors and supervisors assigned to the CAA's huge pilot training program.

Most of the planes are assigned to the General Inspection Division and to the War Training Service. They are used by CAA officials who carry their offices with them in brief cases and transact their business in the field. END

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Synthetics in airplane tires do not mean just synthetic rubber. They also include rayon and Nylon which, in their fields, seem to hold just as great a future. Where this combination of synthetics may lead is still unknown, but whether made from Nylon, from rayon, from cotton cords, or from spider-web-thin steel, from synthetic rubber or natural rubber, "U.S." will build better and better tires as its technical men open up new methods and new materials for the America of tomorrow.

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Flight to Moscow

(Continued from page 47)

the rest of us were quite free to do what we liked. We were treated as guests of the USSR and had suites in the National Hotel, two limousines to serve us, and an interpreter-guide who formerly worked for the Russian tourist agency.

"I know you're more interested in the flight than in my meandering—the boys called me the 'poor man's Wendell Wilkie' because I tried so hard to see everything and learn a lot—but I'll mention one of the things I saw. There were about three bushels of brand new iron crosses captured from Germans trying to take Moscow. The Germans had planned to give them to the conquering soldiers marching into the Russian capital. Now they're on display for the Russian people to laugh at."

Swede resumed. "Instead of giving me maps, charts and radio information for the trip home, the Red Army sent out to the various fields on the routes for experts to confer with me in Moscow before we set out. I even talked with some of the men who had pioneered the routes."

"We were in Moscow 10 days," Brick added, "and Ted Vreeland and I gave the plane a 100-hour check with the aid of a line engineering officer named Capt. Platinov, who was of great help to us. We had to stock up on oxygen. Their bottles didn't fit our equipment, so he had new fittings made while we waited. The Red Army bent over backward to help us every place we stopped. Although their facilities often were not up to American standards they made up for it by their anxiety to do all they could for us."

Davies said, "We had Russian radio operators and navigators during our flying in the USSR, so there were times when some of us didn't have much to do. The other boys said we should have been listed as passengers rather than crew members."

"And good men they were," Swede avowed. "They were very capable Red Army officers and nice fellows. They sure liked our equipment. Most of our trip home was made in instrument weather. Occasionally we could catch glimpses below us of desolate plains or snow-capped mountains, but on the whole it was a quiet trip across. We made several stops but none of them for any length of time.

"At one place hundreds of miles from Moscow I ran into one of the experts with whom I had conferred a few hours before leaving. It was a great surprise. On questioning him I learned he had left the capital two hours before us in an American-type pursuit plane and had landed at each field along the way. He was being sure that everything was in order for us. He had arrived only a short time before us. Incidentally the Russians were quite sold on our plane.

"While we were on this leg of the flight over the jagged mountains, on instruments at 15,000 feet, I reflected on the routine nature of our trip. We were plowing steadily through heavy snow and sleet. Turbulence was rather severe, possibly caused by the mountains a few thousand feet below us. I saw ourselves in a strange perspective. Flying through anything but good weather over terrible terrain and it never occured to any of us to be worried. What a tribute that peace of mind is to the makers of airplanes and airplane engines!"

"Swede, tell him about that beautiful job of navigating Redpath and Hart performed," Brick suggested.

"It was close to home," Swede recalled. We were cruising at 5,000 feet with mountainous land in sight a little to our left. It was night. Without warning we went on instruments. The temperature was 1° above freezing at our level, so we couldn't gain altitude to clear those mountains, because of icing. The navigator set a course 30° to the right, away from the mountains and out to sea.

"There was no visibility and we couldn't get a radio fix. The navigators set a time by dead reckoning at which we should make a left turn. The estimated arrival over a check point was 53 minutes after the hour. We followed the navigators' course and actually arrived at 52 minutes after the hour.

"I've mentioned the two high points of the trip so far—seeing Stalingrad and meeting Stalin. There was one other. You see, we'd been heading in an easterly direction ever since leaving Washington, almost. We thought of it as a trip to Moscow and back. But when I saw the Washington Monument just 15 minutes in front of me, and I was still flying east, it struck me suddenly that we were completing a trip around the world! That was the most personally satisfying moment of the whole trip for me."

The big plane pulled up at the passenger station at Washington National Airport. This time there was no secrecy. Photographers and reporters swarmed around Mr. Davies and his important-looking sealed brief-case. He posed for a few minutes, than rushed off to the White House.

"It was a wonderful trip," said Golien, "but I'm not sorry to be home." END

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Sea Birds

(Continued from page 34)

clude single-engined Grummans and the twin-engined J4F's, as well as OS2U-3 observation scouts. These planes have been equipped with depth bombs and other armament to increase their effectiveness against submarines.

There are four types of operations carried on by the pilots and crews of Coast Guard planes: Submarine patrol, convoy coverage, search and rescue.

All Coast Guard aviation bases are under the jurisdiction of the Sea Frontier Command, which embraces eastern, western and gulf frontiers. The success of this command is daily being written into the record of effective warfare against Nazi U-boats.

Once a submarine is spotted, the pilot wastes no time letting his depth charges loose on the target. So quickly do the U-boats crash dive that a plane seldom has a chance for more than one run at the enemy.

Coastwise convoys come under the protecting wings of the Sea Birds. The operation is carried on in this order: Coast Guard planes are notified of the approach of a convoy. They go out to meet it and then accompany the ships through their particular area. When they have escorted the convoy safely through the waters under their commond, they turn them over to planes patrolling the next zone. This is continued until the convoy has reached port safely on its vital wartime mission.

The third operation of the Coast Guard —that of search—is an important one at all times, and particularly so in wartime. When a ship is torpedoed and sinking, its wireless crackles out an SOS. This is picked up by Sea Frontier headquarters and the location of the sinking ship is relayed to the nearest Coast Guard air station. Planes are immediately sent out to search for survivors.

The fourth and final operation of Coast Guard aviation is that of rescue work in all of its ramifications. For example, a destroyer at sea wirelesses that it has an appendicitis case aboard, or a merchant ship reports a deck hand seriously ill and in immediate need of medical attention. The Coast Guard pilot gets on the job in a hurry.

As recently as 1941, there were only a handful of pilots in the Coast Guard—91, to be exact—but all were graduates of the Naval Air Station at Pensacola.

The problem of personnel is being met by a training program that today finds many more commissioned Coast Guard aviators and enlisted aviation pilots in the service.

During peacetime the Coast Guard's small group of less than 100 pilots won five Distinguished Flying Crosses. In wartime that number will be greatly increased. Coast Guard aviation shares the feelings of the rest of the service as expressed by its commandant, Vice Adm. R. R. Waesche:

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END

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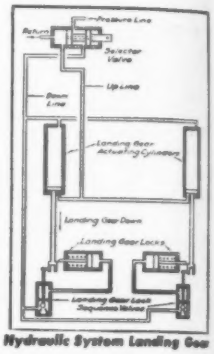

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(*Continued from page 8*)

tially to the fact that it is one of the "cleanest" airplanes flying. At its best altitude this fighter can outmaneuver and outperform anything else. Its maximum speed is over 400 m.p.h.

In a sense, it is unfair to list assets and liabilities so bluntly. Like any other airplane, the *Thunderbolt* can only be expected to do the job for which it was designed. In the case of this fighter, that job is to escort high-flying daylight bombers. To achieve this, performance at low and medium altitudes must be sacrificed. Bearing that in mind, then, the *Thunderbolt* could only be criticized fairly in that it lacked sufficient range. This was obvious to the AAF as soon as the *Thunderbolt* went operational in this theater, and steps already have been taken to correct it.

* * * * *

Indications here now are that four four-engined bomber types will win for the Allies in this theater of operations. This prediction is made because so many people in the United States are waiting for new bombardment giants to come over here and win the war overnight.

Those four bombers are the Avro *Lancaster*, Boeing *Flying Fortress*, Consolidated *Liberator* and Handley Page *Halifax*.

It is a common tendency in the States to discount the efficacy of types of aircraft that have been in use for some time. That this tendency is not justified by the facts is the AAF attitude toward the *Flying Fortress* and *Liberator* here, from generals to mechanics. For the job they are doing—and will be expected to do from now on—they are the best aircraft of their type in the world. Everyone over here has just one request, and that is that they be sent twice as many of these aircraft as they already have.

* * * * *

The sloppy, oil-spattered, stubble-faced mechanic is, by all odds, a 14-carat hero over here. And if you think the pilots and their crews who risk their necks over Germany resent such a statement, you're mistaken. On the contrary, they sing the praises of the "grease monkey" in an unending chorus.

The mechanics I have seen over here so far are real guys Some had been working steadily for 16 hours and, instead of knocking off for some sleep, insisted on pacing the airport nervously awaiting the return of their planes. Being a mechanic on their own special bomber or fighter does something to their outlook on life. They spend 50 per cent of their time getting their planes to stopwatch perfection, and the other 50 per cent trying to figure out ways to give their flight crews even more perfection.

Many pilots say their mechanics deserve medals just as much as the combat crews. They feel that, although they (the flyers) do the fighting and shooting for which medals are awarded, their chances of even being around to collect the medals would be tremendously lessened if it weren't for the fanatical devotion of the mechs. They told me of a number of mechanics who frequently refused to take their regular leaves because their planes would be turned over to other ground crews to maintain.

It has been suggested here that a mechanic should be given a decoration after his particular plane has completed a certain number of missions successfully. This, many pilots feel, is the only fair thing to do, especially in view of the fact that air crews automatically are given medals for completing certain numbers of missions.—M.K.

Max Karant, managing editor of FLYING, *sent the foregoing dispatch from England, where he is visiting Allied air bases and acquiring first hand knowledge of current aerial combat operations.*—ED.

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Skip-Bombing

(*Continued from page 29*)

ever, it was found that when attacking a convoy of closely bunched ships, it was better to use high level, precision methods as the low-flying, skip-bombers would encounter withering antiaircraft fire.

Skip-bombing has become almost a daily assignment in the Aleutian theater and was used steadily during the Kiska land and sea attacks.

A typical attack was one on October 16, 1942, when a formation of B-26's destroyed two Jap destroyers of the Hibiki class. Escorted by four Lockheed *Lightnings*, the bombers made their runs from stem to stern following a concentrated strafing attack by the *Lightnings*.

The attack differed from those in the African theater in that the fighters met with no fighter resistance during the raid and were free to silence the antiaircraft batteries before the bombers made their runs.

The bomber crews reported that they came in at masthead height—about 50 feet—and rocked the Jap ships with 500-pound general purpose bombs.

Skip-bombing tactics may change as the war progresses and reports come to Washington from the fighting fronts. Improvements will be made in planes to make them and the attacks more effective.

The high command recognizes that surprise is of prime importance in most skip-bombing attacks. On usual raids, where heavy antiaircraft fire and possible fighter opposition is expected, medium altitude and low level bombers should attack at the same time.

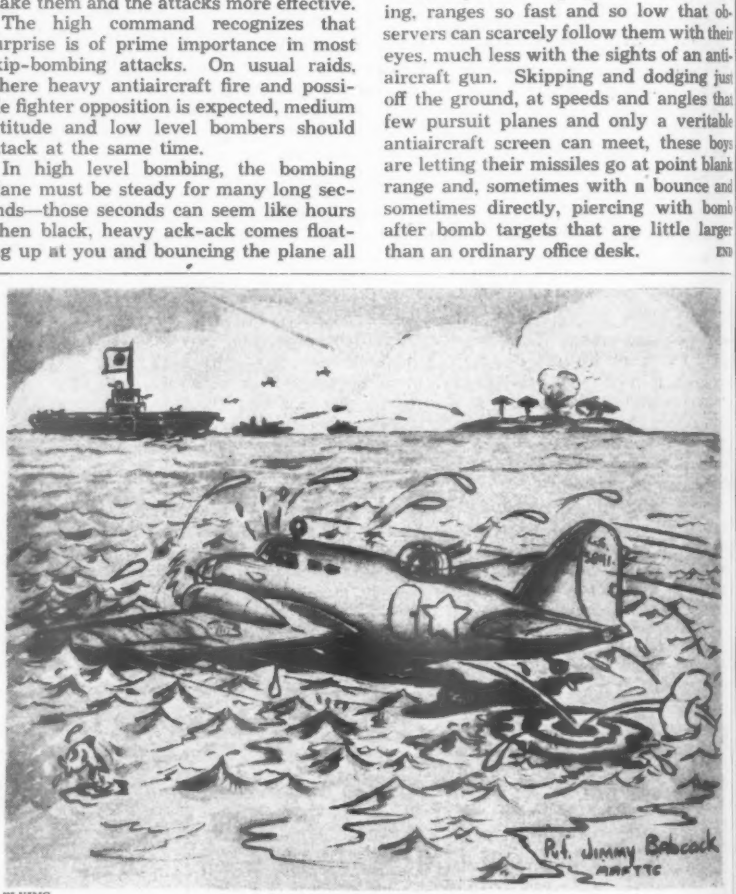
In high level bombing, the bombing plane must be steady for many long seconds—those seconds can seem like hours when black, heavy ack-ack comes floating up at you and bouncing the plane all over the sky. That wait before the release seems almost never ending.

On the other hand, skip-bombing is done at low altitudes, close to the ground or water. Because the plane is constantly jumping around, it offers enemy gunners little to shoot at. Too, the straight and level run prior to dropping the load is only a few seconds—and then it is all over.

At least one of the men who began the development of this technique in the Southwest Pacific is back here in the United States watching its further development. He is Brig. Gen. William D. Lynd. While making one of his first skip-bombing runs in the Southwest Pacific last year, General (then Colonel) Lynd sank two Jap ships on the same run.

No warfront report gave General Lynd greater satisfaction than the description of how low-flying, flack-dodging American planes actually "skipped" bombs into the doorways of the caves of Pantelleria which the Italians were using as underground hangars.

General Lynd and veterans like him now are watching the training of more skip-bombers here in the United States. These boys are dodging in over the training ranges so fast and so low that observers can scarcely follow them with their eyes, much less with the sights of an antiaircraft gun. Skipping and dodging just off the ground, at speeds and angles that few pursuit planes and only a veritable antiaircraft screen can meet, these boys are letting their missiles go at point blank range and, sometimes with a bounce and sometimes directly, piercing with bomb after bomb targets that are little larger than an ordinary office desk. END



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CONTRACTORS TO THE U. S. ARMY AIR FORCES

Report from Washington

(*Continued from page 48*)

fighter airplanes with tremendous rates of climb, able to rise and meet the enemy and destroy him on short notice. America, with her different geography and her different approach to war, has been developing large bombers capable of going great distances to meet the enemy, equipped with the most powerful defensive armament known to ward off enemy fighters, and able to drop bombs in daylight with new records of precision from very high altitudes. We have been developing an outstanding group of Naval planes designed to strike heavy blows far from home bases. We have seen American-developed fighters which were rugged enough to withstand tremendous abuse in the air and still reach their objective or stay in the air slugging it out to bring their pilots home safely. These fighters were given as much range as possible and still keep them in the fighter class.

America made another real contribution in the field of light and medium bombing where its two-engined bombers, in many instances, had the speed and maneuverability of fighters and could still strike heavy blows on ground objectives from their bombs racks. She also contributed the high-level-precision long-range heavy bomber and an outstanding group of specialized airplanes for naval use.

Britain developed the defensive night fighter and the revolutionary power gun turret so necessary during the latter stage of the Battle of Britain and, again, used its great knowledge of Radar as a step forward in the development of specialized aircraft for new and ever-changing aerial warfare.

When you add together the fighting air fleet of Britain and the fighting air fleet of America, each consisting of planes developed for specific but unlike purposes, you must be impressed with the fact that the Allied nations are equipped for global aerial warfare to a degree unknown to our enemies. It is highly improbable that any one nation could have developed such a mass and variety of equipment solely by its own efforts. It is more remarkable that these results were obtained in the face of the small peacetime appropriations for development work.

And now that the war has turned and we feel we are on the straight road to victory, it is time to review the lessons which experience teaches, for as citizens it is our obligation to decide the policies of Government in relation to the maintenance of our military forces. We would be foolish, indeed, if we shut our eyes to the fact that in this war we have been saved by a series of unanticipated events. For now, most of us realize that our military record from the Revolution to the naval War of 1812, to the Mexican War, to the Civil War, to the Spanish-American War, to World War I and, lastly, to World War II, has been a complete record of military unpreparedness. In each of these conflicts we have been saved by one or another twist of fortune and while we, therefore, take great pride in being a nation that has never lost a war, it is doubtful indeed if this record could be maintained under the policy of pacifism and disarmament which has governed us as a people throughout peacetime eras.

So, as we thoughtfully look back, let us learn from our own history and prepare for World War III. Let that preparation be for an entirely different purpose, bearing in mind that the material of modern war is developed in peacetime.

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And so, let us ask ourselves the question whether we want to depend on *fortuitous circumstances* to save us again, or whether America, armed and ready, shall speak with a voice so loud that the international bullies of the future will pause and decide that the odds are so definitely against them that their sense of self-preservation will force them to negotiate in peace and be content with the world's judgment.

In short, if we Americans, in the peace that lies ahead, prepare for World War III with thoughtful adherence to our experiences and lessons of the past, World War III will, in all probability, never be fought. END

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Prelude to Flight

(*Continued from page 26*)

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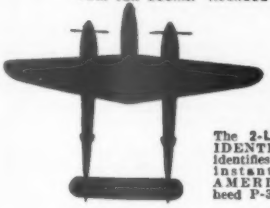

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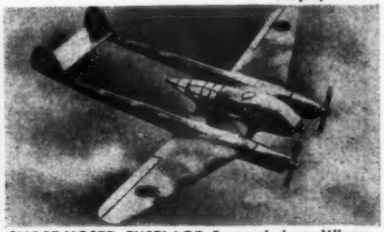

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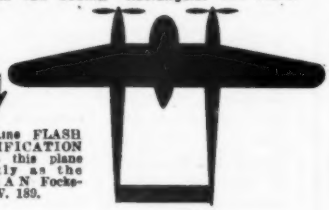

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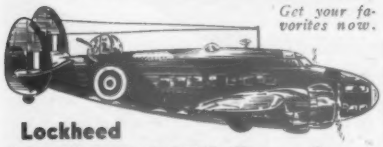

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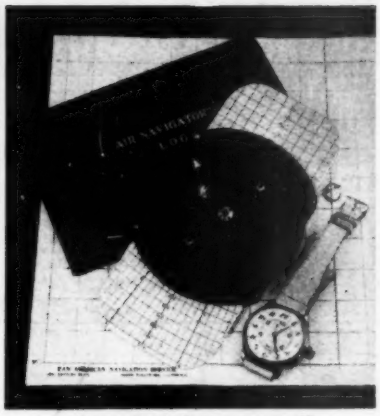

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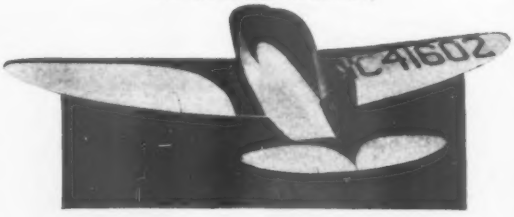

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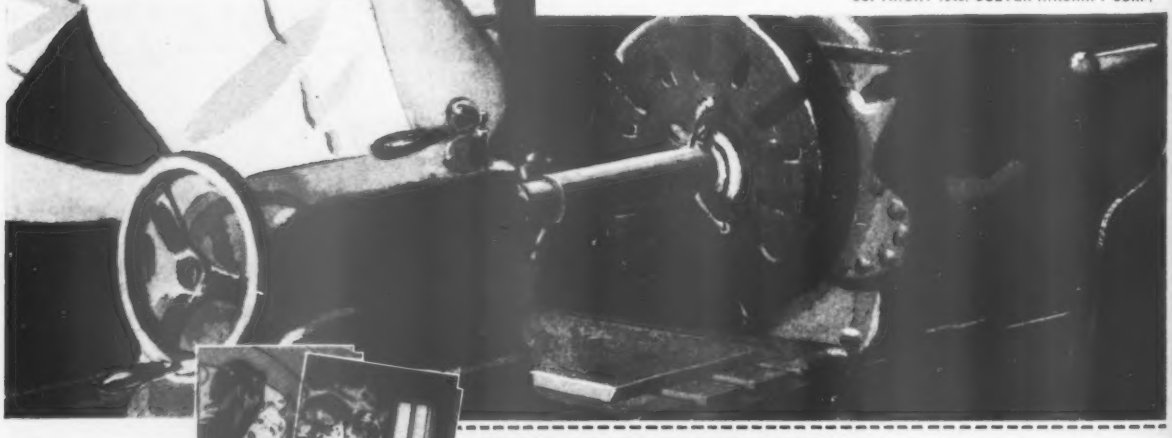

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